Curriculum for B.E in MECHANICAL ENGINEERING

Regulation 2022

CHENNAI INSTITUTE OF TECHNOLOGY

Document Version

Version Number	Date	Author	Major Updates	Approved by
1	30.03.2024	Dr J Rajaparthiban	Format and Font needs to be changed	
2	04.04.2024	Dr J Rajaparthiban	Slight revision of College logo	

Section 1: General Course Structure

A. Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit

B. Structure of Program

S. No.	Category	Credits
1	Humanities & Social Science Courses (HSMC)	9
2	Basic Science Courses (BSC)	23
3	Engineering Science Courses (ESC)	26
4	Program Core Courses (PCC)	62
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Employability Enhancement Skills (EES)	20
8	Mandatory Course (MC)	0
	TOTAL	164

C. Course code and definition

Code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits
<ME>	Professional core courses
<ME>PE	Professional Elective courses
<ME>OE	Open Elective Courses
<ME>MC	Mandatory Courses

- **Course level coding scheme:** Four-digit number used as suffix with the Course Code for identifying the level of the course. Thousand's place denotes regulation number (we use "3" for 2022-23 Regulation) Digit at hundred's place signifies
  The semester in which course is offered. Last two digits represent the serial order of course within the semester. For example, 3101, 3102, … are courses offered during first semester.

D. Category-wise Courses

Humanities & Social Science Courses (HSMC)

S. No.	Course Title	Semester	L-T-P-C
1	HS2101 Communicative English -I	1	3-0-0-3
2	HS2109 -Communicative English Laboratory	1	0-0-2-1
3	HS2201Communicative English - II	2	2-0-2-3
4	HS2301 தமிழர் மரபு / Heritage of Tamils	3	1-0-01
5	HS2401- தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	4	1-0-01
		Total Credits	**09**

Basic Science Courses (BSC)

S. No.	Course Title	Semester	L-T-P-C
1	MA2102 Matrices and Calculus	1	3-1-0-4
2	PH2103 Engineering Physics	1	3-0-0-3
3	CH2104 Engineering Chemistry	1	3-0-0-3
4	BS2107 Physics and Chemistry Laboratory	1	0-0-4-2
5	MA2202 Statistics and Numerical Methods	2	3-1-0-4
6	PH2202 Material Science	2	3-0-0-3
7	MA2301 Transforms and Partial Differential Equations	3	3-1-0-4
		Total Credits	**23**

Engineering Science Courses (ESC)

S. No.	Course Title	Semester	L-T-P-C
1	CS2105 Problem Solving using Python	1	3-0-0-3
2	CS2108 Problem Solving using Python Laboratory	1	0-0-4-2
3	EE2211 Fundamentals of Electrical and Electronics Engineering	2	3-0-0-3
4	ME2201 Engineering Mechanics	2	3-0-0-3
5	ME2202 Engineering Graphics	2	2-0-4-4
6	CS2211Fundamentals of C Programming	2	2-0-2-3
7	ME2203 Engineering Practices Laboratory	2	0-0-4-2
8	EE2301Electrical Drives and Controls	3	3-0-0-3
9	CS2407 Introduction to AIML	4	3-0-0-3
		Total Credits	**26**

Program Core Courses (PCC)

S. No.	Course Title	Semester	L-T-P-C
1	ME2301 Engineering Thermodynamics	3	3-0-0-3
2	ME2302 Fluid Mechanics and Machinery	3	3-0-2-4
3	ME2303 Manufacturing Technology	3	3-0-2-4
4	ME2304 Solid Mechanics	3	3-0-2-4
5	ME2305 Core Course Project – I	3	0-0-2-1
6	ME2401 Hydraulics and Pneumatics	4	3-0-0-3
7	ME2402 Engineering Metallurgy	4	3-0-0-3
8	ME2403 Mechanics of Machines	4	3-0-2-4
9	ME2404 Thermal Engineering	4	3-0-2-4
10	ME2405 Welding Technology	4	2-1-2-4
11	ME2406 Core Course Project – II	4	0-0-2-1
12	ME2501Design of Machine Elements	5	3-0-0-3
13	ME2502Heat and Mass Transfer	5	3-0-0-3
14	ME2503 Product Life Cycle Management	5	3-0-2-4
15	ME2504 Core Course Project – III	5	0-0-2-1
16	ME2601 Design of Transmission Systems	6	3-0-0-3
17	ME2602 Finite Element Analysis	6	2-0-2-3
18	ME2603 Computer Aided Design and Manufacturing	6	2-0-2-3
19	ME2701 Process Planning and Cost Estimation	7	2-0-0-2
20	ME2702 Automobile Engineering	7	2-0-0-2
21	ME2703 Industrial Internet of Things	7	3-0-0-3
		Total Credits	**62**

Professional Elective courses

S. No.	Course Title	Semester	L-T-P-C
1	ME2VXX-Professional Elective – I	V	3-0-0-3
2	ME2VXX-Professional Elective – II	V	3-0-0-3
3	ME2VXX-Professional Elective – III	V	3-0-0-3
4	ME2VXX-Professional Elective – IV	VI	3-0-0-3
5	ME2VXX-Professional Elective – V	VI	3-0-0-3
6	ME2VXX-Professional Elective – VI	VI	3-0-0-3
		Total Credits	**18**

Open Elective Courses (OEC)

S. No.	Course Title	Semester	L-T-P-C
1	ME26OX-Open Elective – I	VI	3-0-0-3
2	ME27OX-Open Elective – II	VII	3-0-0-3
		Total Credits	**6**

Mandatory Course (MC)

S. No.	Course Title	Semester	L-T-P-C
1	MC2301-Mandatory Course-I	III	2-0-0-0
2	MC2401-Mandatory Course-II	IV	2-0-0-0
		Total Credits	**0**

Employability Enhancement Skills (EES)

S. No.	Course Title	Semester	L-T-P-C
1	ES2106-Employability Enhancement Skills – I	I	3-0-0-3
2	ES2201-Employability Enhancement Skills – II	II	0-0-2-1
3	ME2604-Miniproject	VI	0-0-4-2
4	ME2704-Internship	VII	0-0-4-2
5	ME2801-Projectwork	VII	0-0-24-12
		Total Credits	**20**

E. Induction Program

- ***Catapult*** is a dynamic week-long event designed for our incoming first-year students, offering an immersive introduction to the diverse array of clubs and activities across the college campus. In addition to familiarizing them with our labs and Centers of Excellence (COEs), Catapult aims to acclimate first-year students to college life, ensuring they feel at ease with the forthcoming experiences of their four-year journey.
- This initiative fosters meaningful connections between seniors and juniors, providing a platform for them to explore departmental projects and engage in collaborative activities, thereby enhancing camaraderie and knowledge sharing within the college community.

F. **Evaluation Scheme**

a. **For Theory Courses:**

The weightage of Internal assessment is 40% and for End Semester Exam is 60%
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

b. **For Practical Courses:**

The weightage of internal assessment is 60% and for End Semester Exam is 40%
For Theory cum Lab
The student has to obtain at least 50% marks individually both in Internal assessment and end semester exams to pass.

c. **For Theory Cum Practical Courses:**

The weightage of Internal assessment is 50% and for End Semester Exam is 50%
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

Note: The internal assessment is based on the student's performance in 3 Internal Assessment (IA) exams, quizzes, assignments, class performance, attendance, etc.

d. **For Project works:**

Assessment of project works comprises three internal reviews and an end-of-semester evaluation. Internal reviews, worth 40 marks in total, encompass assessment criteria such as Project Synopsis/Proposal Evaluation, Methodology and Design of Existing System, Feasibility of Project Proposal, Planning of Project Work, and Team Work. At the conclusion of the semester, 20 marks are designated for assessing the quality of the report, while the remaining 40 marks are reserved for evaluating performance in viva-voce, demonstration of the work, and other relevant factors.

G. **Learning Beyond Class Room**

a. Students should be encouraged to visit Centers of Excellence (COEs) in the campus and learn additional technical skills
b. Students should be encouraged to participate in internal / external competitions, hackathons, etc. on a regular basis

Section 2: Semester wise Structure and Curriculum for B.E in MECHANICAL ENGINEERING

Semester I							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	-	IP2100	Induction Programme	2	0	0	0
2	T	HS2101	Communicative English - I	3	0	0	3
3	T	MA2102	Matrices and Calculus	3	1	0	4
4	T	PH2103	Engineering Physics	3	0	0	3
5	T	CH2104	Engineering Chemistry	3	0	0	3
6	T	CS2105	Problem Solving using Python	3	0	0	3
7	T	ES2106	Employability Enhancement Skills	3	0	0	3
8	P	BS2107	Physics and Chemistry Laboratory	0	0	4	2
9	P	CS2108	Problem Solving using Python Laboratory	0	0	4	2
10	P	HS2109	Communicative English Laboratory	0	0	2	1
						Total	**24**

Semester II							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MA2202	Statistics and Numerical Methods	3	1	0	4
2	T	PH2202	Material Science	3	0	0	3
3	T	EE2211	Fundamentals of Electrical and Electronics Engineering	3	0	0	3
4	T	ME2201	Engineering Mechanics	3	0	0	3
5	T & P	ME2202	Engineering Graphics	2	0	4	4
6	T & P	CS2211	Fundamentals of C Programming	2	0	2	3
7	T & P	HS2201	Communicative English - II	2	0	2	3
8	P	ME2203	Engineering Practices Laboratory	0	0	4	2
9	P	ES2201	Employability Enhancement Skills -II	0	0	2	1
						Total	**26**

Semester III							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MA2301	Transforms and Partial Differential Equations	3	1	0	4
2	T	ME2301	Engineering Thermodynamics	3	0	0	3
3	T	EE2301	Electrical Drives and Controls	3	0	0	3
4	T	MC2301	Mandatory Course-I	2	0	0	0
5	T	HS2301	தமிழர் மரபு / Heritage of Tamils	1	0	0	1
6	T & P	ME2302	Fluid Mechanics and Machinery	3	0	2	4
7	T & P	ME2303	Manufacturing Technology	3	0	2	4
8	T & P	ME2304	Solid Mechanics	3	0	2	4
9	P	ME2305	Core Course Project – I	0	0	2	1
						Total	**24**

Semester IV							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	CS2407	Introduction to AIML	3	0	0	3
2	T	ME2401	Hydraulics and Pneumatics	3	0	0	3
3	T	ME2402	Engineering Metallurgy	3	0	0	3
4	T	MC2401	Mandatory Course-II	2	0	0	0
5	T	HS2401	தமிழரும் தொழில் நுட்பமும் / Tamils and Technology	1	0	0	1
6	T&P	ME2403	Mechanics of Machines	3	0	2	4
7	T&P	ME2404	Thermal Engineering	3	0	2	4
8	T&P	ME2405	Welding Technology	2	1	2	4
9	P	ME2406	Core Course Project – II	0	0	2	1
						Total	**23**

Semester V							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	ME2501	Design of Machine Elements	3	0	0	3
2	T	ME2502	Heat and Mass Transfer	3	0	0	3
3	T	ME2VXX	Professional Elective I	3	0	0	3
4	T	ME2VXX	Professional Elective II	3	0	0	3
5	T	ME2VXX	Professional Elective III	3	0	0	3
6	T & P	ME2503	Product Life Cycle Management	3	0	2	4
7	P	ME2504	Core Course Project – III	0	0	2	1
						Total	**20**

Semester VI							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	ME2601	Design of Transmission Systems	3	0	0	3
2	T & P	ME2602	Finite Element Analysis	2	0	2	3
3	T & P	ME2603	Computer Aided Design and Manufacturing	2	0	2	3
4	T	ME2VXX	Professional Elective IV	3	0	0	3
5	T	ME2VXX	Professional Elective V	3	0	0	3
6	T	ME26OX	Open Elective Course-I	3	0	0	3
7	P	ME2604	Mini Project	0	0	4	2
						Total	**20**

Semester VII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	ME2701	Process Planning and Cost Estimation	2	0	0	2
2	T	ME2702	Automobile Engineering	2	0	0	2
3	T	ME2703	Industrial Internet of Things	3	0	0	3
4	T	ME2VXX	Professional Elective VI	3	0	0	3
5	T	ME27OX	Open Elective Course -II	3	0	0	3
6	P	ME2704	Internship	0	0	4	2
						Total	**15**

Semester VIII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P	ME2801	Project Work	0	0	24	12
						Total	**12**

Course Code	COMMUNICATIVE ENGLISH – I	L	T	P	C
HS2101		3	0	0	3

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs,definitions, essays and user manuals.

COURSE DESCRIPTION

This course aims to develop students' proficiency in English language skills, focusing on speaking, listening, reading, and writing. Emphasis is placed on real-life communication situations to enhance students' ability to interact effectively in various contexts.

PREREQUISITES

- Basic knowledge of English grammar
- Vocabulary is recommended for successful participation in this course.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 9

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 9

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs

UNIT III DESCRIPTION OF A PROCESS PRODUCT 9

Reading — Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Reading – Newspaper articles; Journal reports –and Non Verbal Communication (tables, pie charts etc,). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart , graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed /Semi fixed expressions.

UNIT V EXPRESSION 9

Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, learners will be able

- To use appropriate words in a professional context
- To gain understanding of basic grammatic structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English,Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt.Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN: 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi, 2003.

YOUTUBE RESOURCES

1. **BBC Learning English**

   ENGVID: EngVid features lessons by experienced English teachers on various topics such as grammar, speaking skills, idioms, and pronunciation. The videos are engaging and suitable for learners at different levels.

2. **ENG VID**

    Learn English with Mister duncan: This channel offers lessons in a fun and entertaining format, covering grammar, vocabulary, and common English phrases. Mister duncan's engaging style makes learning English enjoyable.

3. **Learn English with Mr Duncan**

    Rachel's English: Rachel's English focuses on pronunciation and accent reduction. The channel provides clear explanations, practice exercises, and tips to improve spoken English clarity and fluency.

4. **Rachel's English**

    TED-Ed: Lessons Worth Sharing: TED-Ed features animated lessons on a wide range of topics, including language and communication. Students can explore TED-Ed's library for insightful talks and discussions related to effective communication skills.

ASSESSMENT PATTERN

Two internal assessments and an end semester examination to test students' reading and writing skills along with their grammatic a land lexical competence

Course code	MATRICES AND CALCULUS	L	T	P	C
MA2102		3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branchesof engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE DESCRIPTION

This course provides an in-depth exploration of matrices and calculus, two fundamental areas of mathematics with wide applications in science, engineering, economics, and various other fields. Students will learn the essential concepts, techniques, and applications of matrices, linear algebra, and calculus to solve mathematical problems and analyze real-world phenomena.

PREREQUISITES

- Basic knowledge of algebra, calculus, and linear algebra is recommended for successful completion of this course.
- Familiarity with mathematical notation and terminology is also beneficial.

UNIT I MATRICES **9 + 3**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS **9 + 3**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9 + 3**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **9 + 3**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V MULTIPLE INTEGRALS 9 + 3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double andtriple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL: 60 HOURS

COURSE OUTCOMES:

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4and 7.8].

REFERENCES:

1. Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016
2. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.
4. Narayanan.S.and Manicavachagom Pillai.T.K.,“Calculus" Volume Iand II Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Srimantha Pal and Bhunia. S.C, "Engineering Mathematics” Oxford University Press, 2015.
7. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus ", 14th Edition, Pearson India, 2018

YOUTUBE RESOURCES

1. **Khan Academy - Linear Algebra:** Khan Academy offers a comprehensive series of videos on linear algebra, including matrices, vectors, eigenvalues, and eigenvectors. The content is well-structured and suitable for beginners and intermediate learners.
2. **Patrick JMT - Calculus**: Patrick JMT's channel provides clear and concise explanations of calculus topics, including limits, derivatives, integrals, applications of derivatives, and differential equations.
3. **Professor Leonard -** Calculus 1: Professor Leonard's lectures cover calculus topics in-depth, including functions, limits, derivatives, integrals, and applications. The explanations are detailed and suitable for college-level calculus courses.
4. **Blue1Brown -** Essence of Linear Algebra: This series by 3Blue1Brown provides a visual and intuitive understanding of linear algebra concepts, including vectors, matrices, transformations, and eigenvalues. The animations and explanations are engaging and insightful

Course Code	ENGINEERING PHYSICS	L	T	P	C
PH2103		3	0	0	3

COURSE OBJECTIVES

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

COURSE DESCRIPTION

This course provides a comprehensive introduction to the fundamental principles of physics and their applications in engineering disciplines. It covers a range of topics including classical mechanics, electromagnetism, thermodynamics, optics, and modern physics concepts. Emphasis is placed on developing problem-solving skills, critical thinking, and the ability to apply physics principles to engineering problems and technologies.

PREREQUISITES

Basic knowledge of algebra, trigonometry, calculus, and physics principles (e.g., Newtonian mechanics, electromagnetism) is recommended for successful participation in this course.

UNIT I MECHANICS 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum – Introduction to nonlinear oscillations.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interfacefor normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems- waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes-Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling (qualitative)-Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 HOURS

COURSE OUTCOMES

After completion of this course, the students should be able to

- Understand the importance of mechanics.
- Express their knowledge in electromagnetic waves.
- Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
- Understand the importance of quantum physics.
- Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition),2017.
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill(Indian Edition), 2017.

REFERENCES:

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (IndianEdition), 2019.
4. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag,2012.

YOUTUBE RESOURCES

1. **MIT Open Course Ware -** Physics: MIT offers a collection of physics courses covering various topics relevant to engineering physics, such as classical mechanics, electromagnetism, thermodynamics, and modern physics.
2. **Walter Lewin Lectures -** MIT: Walter Lewin's physics lectures from MIT cover classical mechanics, electromagnetism, waves, optics, and special relativity. His engaging teaching style makes complex concepts easier to understand.
3. **The Physics Classroom:** This channel provides tutorials, animations, and demonstrations covering a wide range of physics topics, including mechanics, waves, electricity, magnetism, and modern physics.

4. **Crash Course Physics:** Crash Course offers a series of engaging videos on physics topics, including classical mechanics, electricity, magnetism, waves, optics, and modern physics concepts.

Course Code	ENGINEERING CHEMISTRY	L	T	P	C
CH2104		3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties andcombustion characteristics.
- To familiarize the students with the operating principles, working processes and applications ofenergy conversion and storage devices.

COURSE DESCRIPTION

This course provides a foundational understanding of chemistry principles and their applications in engineering disciplines. It covers key topics such as atomic structure, chemical bonding, thermodynamics, kinetics, electrochemistry, materials science, and environmental chemistry. Emphasis is placed on linking fundamental chemical concepts to engineering applications and technological advancements.

PREREQUISITES

- Basic knowledge of chemistry concepts, including atomic structure, chemical bonding, stoichiometry, and thermodynamics, is recommended for successful participation in this course.
- Proficiency in algebra and basic calculus is also beneficial.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment — Ion exchange demineralization and zeoliteprocess.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of — nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear powerplant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles — working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 HOURS

COURSE OUTCOMES

At the end of the course, the students will be able:

- To infer the quality of water from quality parameter data and propose suitable treatmentmethodologies to treat water.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing thesynthesis of nanomaterials for engineering and technology applications.
- To apply the knowledge of phase rule and composites for material selection requirements.
- To recommend suitable fuels for engineering processes and applications.
- To recognize different forms of energy resources and apply them for suitable applications inenergy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi,2008.
3. S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition,2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.

4. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge UniversityPress, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists,Springer Science Business Media, New York, 2nd Edition, 2013.

YOUTUBE RESOURCES:

1. **Chemical Engineering Guy:** This channel covers various topics in chemical engineering, including engineering chemistry concepts such as chemical kinetics, thermodynamics, and materials science.
2. **Learn ChemE - Chemical Engineering:** Learn ChemE offers a series of video tutorials and lectures on chemical engineering topics, including chemistry fundamentals, process design, and materials engineering.
3. **MIT Open Course Ware - Chemistry**: MIT's Open Course Ware provides lectures and course materials on chemistry topics relevant to engineering, such as organic chemistry, physical chemistry, and chemical kinetics.
4. **Khan Academy - Chemistry:** Khan Academy's chemistry videos cover fundamental concepts in chemistry, including atomic structure, chemical bonding, thermodynamics, kinetics, and elector-chemistry.

Course Code	PROBLEM SOLVING USING PYTHON	L	T	P	C
CS2105		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tables, dictionaries to represent complex data.
- To do input/output with files in Python.

COURSE DESCRIPTION

This course is designed to introduce students to problem-solving techniques and programming skills using the Python programming language. It covers fundamental programming concepts, data structures, algorithm design, and their practical applications in solving computational problems.

PREREQUISITES

No prior programming knowledge is required, but familiarity with basic mathematical concepts and logical reasoning is beneficial for successful completion of this course.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing — Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if- elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copyfile, Voter's age validation, Marks range validation (0-100).

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems.
- Develop and execute simple Python programs.
- Write simple Python programs using conditionals and looping for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries etc. CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2^{nd} Edition, O'ReillyPublishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving andprogramming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmersand Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, " Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019. https://www.python.org/
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

YOUTUBE RESOURCES

1. Programming with Mosh: This channel offers comprehensive tutorials on Python programming, including problem-solving techniques, data structures, algorithms, and practical coding projects.

2. Corey Schafer - Python Tutorials: Corey Schafer's tutorials cover various aspects of Python programming, including problem-solving strategies, Python libraries, web development, data analysis, and machine learning.

3. Sentdex - Python Programming: sentdex provides tutorials on Python programming, data analysis, machine learning, and artificial intelligence, focusing on problem-solving techniques and coding projects.

4. FreeCodeCamp.org - Python Programming: free Code Camp.org offers tutorials on Python programming for beginners, covering basic syntax, data structures, algorithms, and problem-solving approaches.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – I	L	T	P	C
ES2106		0	0	2	1

COURSE OBJECTIVES

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles

COURSE DESCRIPTION

This course is designed to equip students with essential skills and competencies required for successful entry into the workforce and career advancement. It focuses on developing a range of professional skills, including communication, teamwork, problem-solving, critical thinking, leadership, and adaptability. The course also covers aspects such as resume writing, interview preparation, networking, personal branding, and career planning strategies.

PREREQUISITES

There are no specific prerequisites for this course. However, a willingness to learn, participate actively, and apply acquired skills is essential for maximizing the benefits of the course

UNIT I NUMBERS **6**

Introduction – Classification of numbers – Formation of Numbers (Small & Large) –Place Value – Face Value – Divisibility Rule – Prime, Composite Numbers – Prime Factorization – Number of factors – Number of factors (Odd & Even) – Sum of factors – Successors and Predecessors – Greatest Integer Value – Vedic Mathematics – Trailing Zeroes – Unit Digits–Remainder Theorem – Real Number – Rational Numbers: Integers, Fractions – Comparison of Numbers – Operations on fractions – Scientific Notation

UNIT II PROBLEMS ON LETTERS, NUMBERS AND SYMBOLS **6**

Factors and Multiples, LCM and HCF – Relationship between LCM and HCF – Factorial – Simplification – VBODMAS – Square , Square Root – Cube, Cube Root – Exponents & Powers (Surds and Indices) – Sequence & Series: Arithmetic Progression – Geometric Progression – Special Progression, Letter Series, Number Series, Alpha – Numeric Series, Continuous Pattern Series

UNIT III VERBAL AND NON – VERBAL REASONING **6**

Verbal Reasoning – Analogy: Completing the Analogous pair, Direct Analogy, Choosing the Analogous pair, Double Analogy, Choosing a Similar Word, Detecting Analogies, Multiple word Analogy, Number Analogy, Alphabet Analogy – Classification: Odd Words and Numerals – Coding and Decoding: Letter, Number, Symbol, Matrix, Substitution, Deciphering Message Word, Number and Symbols. Non – Verbal Reasoning Figure Series – Missing figure, Incorrect figure – Analogy: Similarity Related Pair, Similarity Related figures, unrelated figures, Group of figures.

UNIT IV RATIO AND PROPORTION **6**

Introduction – Ratio – Proportion: Direct and Indirect – Unitary Method – Problems on Ages – Chain Rule – Partnership – Mixture or Allegation – Time and Work: Individual, Group, Efficiency, Wages – Pipes and Cistern: Inlet, Outlet, and Leakage

UNIT V PERCENTAGE **6**

Introduction – Percentages in real life – Profit and Loss – Discount – Simple Interest – Compound Interest – Relationship between Simple Interest and Compound Interest – Overhead Expenses and GST.

TOTAL: 30 HOURS

COURSE OUTCOMES

After the completion of the course, students will be able to

- Develop the arithmetic ability and properties of numbers that we use in day to day life,
- Demonstrate the logic behind the formation of numbers, alphabets series.
- Apply the reasoning methods logically and evaluate complex relationships between the variables and numbers.
- Use the concept of ratios and proportion in ages and partnership problems.
- Apply the short cuts of the mathematical tricks to reduce the time duration in problem solving

TEXT BOOKS

1. “Quantitative Aptitude for Competitive Examinations” by R.S. Aggarwal – 2022”
2. “Teach Yourself Quantitative Aptitude” by Arun Sharma – 2017
3. “A modern approach verbal and non – verbal reasoning” by R.S. Aggarwal – 2017

REFERENCES

1. “Shortcuts in Mathematics” by Akhilesh Khare – 2016
2. “Vedic maths for competitive exams” by Ravi Shankar – 2016
3. “Quantitative Aptitude for Competitive Examination” by Abhijit Guha – 2017

YOUTUBE RESOURCES

1**. Career Vidz:** This channel offers videos on career advice, job search strategies, interview tips, resume writing, and personal development.

2**. Work It Daily:** Work It Daily provides videos on career coaching, professional branding, networking, workplace skills, and job search tactics.

3**. Linda Raynier:** Linda Raynier's channel covers topics such as resume writing, interview preparation, career growth strategies, and personal branding.

4**. Andrew LaCivita:** Andrew LaCivita offers videos on career development, job interview techniques, communication skills, and leadership.

Course Code	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
BS2107		0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimentaldata.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

COURSE DESCRIPTION

The Physics and Chemistry Laboratory course provides hands-on experience and practical skills in conducting experiments, data analysis, and scientific inquiry in the fields of physics and chemistry. It emphasizes the application of theoretical concepts learned in classroom lectures to real-world laboratory settings, fostering critical thinking, problem-solving, and experimental design skills.

PREREQUISITES

Completion or concurrent enrolment in relevant physics and chemistry courses covering foundational principles, theories, and concepts is typically required.

EXPERIMENTS

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia ofregular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle

   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions
- To demonstrate the analysis of metals and alloys
- To demonstrate the synthesis of nanoparticles

EXPERIMENTS

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of DO content of water sample by Winkler's method.
3. Determination of chloride content of water sample by Argentometric method.
4. Estimation of copper content of the given solution by Iodometry.
5. Estimation of TDS of a water sample by gravimetry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
9. Estimation of iron content of the given solution using potentiometer.
10. Estimation of sodium /potassium present in water using flame photometer.
11. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
12. Estimation of Nickel in steel
13. Proximate analysis of Coal

TOTAL: 60 HOURS

COURSE OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles
- To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOK:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook ofQuantitative Chemical Analysis (2009).

YOUTUBE RESOURCES:

1. Science Bob: Science Bob offers a variety of science experiment demonstrations and tutorials, including physics and chemistry experiments suitable for laboratory settings.

2. FlameLab: FlameLab provides videos on chemistry experiments, demonstrations, and laboratory techniques, covering topics such as chemical reactions, stoichiometry, and safety protocols.

3. Explosions & Fire: This channel features chemistry experiments, reactions, and demonstrations involving explosive and fire-related phenomena, showcasing safety measures and scientific principles.

4. Chemical Force: Chemical Force offers videos on chemistry experiments, practical demonstrations, and laboratory techniques, focusing on hands-on learning and scientific exploration.

Course Code	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
CS2108		0	0	4	2

COURSE OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

COURSE DESCRIPTION

The Problem Solving and Python Programming Laboratory course is designed to provide hands-on experience in applying problem-solving techniques using Python programming language. The course emphasizes practical programming skills, algorithmic problem-solving, data manipulation, and software development practices. Students will work on a variety of programming projects, exercises, and assignments to reinforce their understanding of programming concepts and enhance their problem-solving abilities.

PREREQUISITES

- Basic knowledge of programming concepts, such as variables, control structures, functions, and algorithms, is recommended.
- Familiarity with Python syntax and basic programming principles will be beneficial.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list &tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy.Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another,word count, longest word)

10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 HOURS

COURSE OUTCOMES:

On completion of the course, students will be able to:

- Develop algorithmic solutions to simple computational problems
- Develop and execute simple Python programs.
- Implement programs in Python using conditionals and loops for solving problems.
- Deploy functions to decompose a Python program.
- Process compound data using Python data structures.
- Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, "Think Python : How to Think like a Computer Scientist", 2nd Edition, O'ReillyPublishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming",1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers andData Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming",2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018

YOUTUBE RESOURCES:

1. **Programming with Mosh:** This channel offers comprehensive tutorials on Python programming, problem-solving techniques, data structures, algorithms, and practical coding projects.
2. **Corey Schafer - Python Tutorials**: Corey Schafer's tutorials cover various aspects of Python programming, including problem-solving strategies, Python libraries, web development, data analysis, and machine learning.
3. **sentdex - Python Programming:** sentdex provides tutorials on Python programming, data analysis, machine learning, and artificial intelligence, focusing on problem-solving techniques and coding projects.

4. **Free Code Camp.org - Python Programming:** freeCodeCamp.org offers tutorials on Python programming for beginners, covering basic syntax, data structures, algorithms, and problem-solving approaches.

Course Code	COMMUNICATIVE ENGLISH LABORATORY	L	T	P	C
HS2109		0	0	2	1

COURSE DESCRIPTION

The Communicative English Laboratory is designed to enhance students' communication skills in English through interactive and immersive learning experiences. The course focuses on developing proficiency in speaking, listening, reading, and writing, with an emphasis on practical communication in various contexts.

PREREQUISITES

- Basic English language proficiency is recommended for students enrolling in the Communicative English Laboratory.
- The course may cater to learners at different proficiency levels, from beginner to advanced.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions(filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III DESCRIPTION OF A PROCESS/PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking — Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities (large & small)-talking about precautions.

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V EXPRESSION 6

Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website- describing processes

TOTAL: 30 HOURS

LEARNING OUTCOMES:

At the end of the course, learners will be able

- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

ASSESSMENT PATTERN

- One online / app based assessment to test listening /speaking
- End Semester **ONLY** listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

YOUTUBE RESOURCES:

1. BBC Learning English: BBC Learning English offers a wide range of videos, lessons, and exercises focusing on English language learning, including pronunciation, vocabulary, grammar, listening, speaking, and communication skills.

2. EngVid: EngVid provides video lessons on various aspects of English language learning, including speaking, writing, and grammar, vocabulary, pronunciation, and communication strategies.

3. Rachel's English: Rachel's English Channel focuses on improving English pronunciation, accent reduction, intonation, and communication skills through clear explanations, practice exercises, and demonstrations.

4. Learn English with Mr Duncan: M r Duncan's channel offers lessons on English language learning, pronunciation practice, idioms, expressions, and communication tips in a friendly and engaging manner.

Course Code	STATISTICS AND NUMERICAL METHODS	L	T	P	C
MA2202		3	1	0	4

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems?
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines?
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

COURSE DESCRIPTION

The Statistics and Numerical Methods course is designed to introduce students to fundamental concepts, techniques, and tools used in statistical analysis and numerical computations. The course covers topics such as descriptive statistics, probability theory, inferential statistics, numerical methods, and data analysis techniques.

PREREQUISITES

- Basic knowledge of mathematics, algebra, and calculus is recommended for students enrolling in the Statistics and Numerical Methods course.
- Familiarity with programming languages (e.g., Python, MATLAB) may be beneficial for numerical computing tasks.

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions - Tests for single mean, and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes

UNIT II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design –Latin square design -2^2 factorial design.

UNIT III SOLUTIONOF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen values of a matrix by Power method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

Lagrange's and Newton's divided difference interpolations- Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single integrations using Trapezoidal and Simpson's1/3rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION 12

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's predictor & corrector methods for solving first order differential equations.

TOTAL: 60 HOURS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS:

1. Grewal B.S., and Grewal,J.S.,"Numerical Methods in Engineering and Science", Khanna Publishers,10th Edition, New Delhi, 2015.
2. Johnson, R.A. Miller, Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F .and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, NewDelhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole.R.E., Myers. R.H., Myers. S.L. and Ye .K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

YOUTUBE RESOURCES:

1. Evaluate Content: Before relying on any YouTube resource, ensure that the content is accurate, reliable, and suitable for your level of understanding. Check the credentials of the creator or channel, read user reviews and comments, and preview the videos to gauge their quality and relevance to your studies.

2. Review Playlists: Look for playlists specifically curated for "Statistics and Numerical Methods" or related topics. These playlists often compile a series of videos that cover different aspects of the subject, making it easier to follow a structured learning path.

3. Check University Channels: Many universities upload lectures and course materials on their official YouTube channels. Search for universities or professors who specialize in statistics, mathematics, or engineering, as they often share valuable resources related to numerical methods and statistical analysis.

4. Explore Educational Channels: Look for reputable educational channels or channels affiliated with universities and educational institutions. Channels like Khan Academy, MIT Open Course Ware, Coursera, edX, and others often provide high-quality lectures and tutorials on various subjects, including statistics and numerical methods.

Course Code	MATERIALS SCIENCE	L	T	P	C
PH2202		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials
- To insist knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications

COURSE DESCRIPTION

The Materials Science course offers an interdisciplinary exploration of the structure, properties, processing, and applications of materials across various engineering and scientific disciplines. It covers fundamental principles, theories, and techniques related to the study of materials, including metals, ceramics, polymers, composites, and semiconductors. Students will learn about material properties, micro-structure analysis, mechanical behavior, thermal properties, electrical properties, and material selection criteria.

PREREQUISITES

- Basic knowledge of physics, chemistry, and mathematics is recommended.
- Familiarity with engineering principles and scientific concepts will be beneficial for understanding advanced topics in materials science.

UNIT I CRYSTALLOGRAPHY **9**

Crystal structures: BCC, FCC and HCP – directions and planes - linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries - Burgers vector and elastic strain energy- Slip systems, plastic deformation of materials - growth of single crystals: solution and melt growth techniques.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS **9**

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression-Quantum free electron theory :Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – domain theory – hysteresis – hard and soft magnetic materials – ferrites.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS **9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state – Electro-optics and nonlinear optics: Modulators and switching devices – plasmonic.

UNIT V NANO ELECTRONIC DEVICES 9

Quantum confinement – Quantum structures – quantum wells, wires and dots – Zener-Bloch oscillations-Resonant tunnelling – quantum interference effects - mesoscopic structures - Single electron phenomena – Single electron Transistor. Active and passive optoelectronic devices – photo processes – spintronics – carbon nanotubes: Properties and applications.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course, the students should be able to

- Know basics of crystallography and its importance for varied materials properties
- Gain knowledge on the electrical and magnetic properties of materials and their applications
- Understand clearly of semiconductor physics and functioning of semiconductor devices
- Understand the optical properties of materials and working principles of various optical devices
- Appreciate the importance of functional nano electronic devices.

TEXT BOOKS:

1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.

2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.

3.MJasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.

4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)

5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017

5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

YOUTUBE RESOURCES:

1. **MIT Open Course Ware - Materials Science and Engineering:** MIT's Open Course Ware program offers free access to lectures, course materials, and resources related to Materials Science and Engineering.
2. **Khan Academy - Chemistry:** Khan Academy covers various topics related to chemistry, including materials science concepts such as atomic structure, chemical bonding, and properties of materials.
3. **ASM International:** ASM International's channel provides videos on materials science, metallurgy, materials testing, and engineering materials.

Course Code	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
EE2211		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.
- To introduce the functional elements and working of measuring instruments.

COURSE DESCRIPTION

The Fundamentals of Electrical and Electronics Engineering course provides a foundational understanding of key principles, theories, and concepts in electrical and electronics engineering. It covers fundamental topics such as electric circuits, electromagnetism, electronic devices, digital systems, and electrical measurements.

Students will learn about the applications of electrical and electronics engineering in various industries, including power systems, telecommunications, electronics, and computer engineering.

PREREQUISITES

- Basic knowledge of physics, mathematics (algebra, calculus), and engineering fundamentals is recommended for students enrolling in this course.
- Familiarity with circuit analysis, electronic components, and basic programming concepts may be beneficial.

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Components: Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state), Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor

UNIT III ANALOG ELECTRONICS 9

Semiconductor Materials: Silicon& Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters.

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 HOURS

COURSE OUTCOMES:

- After completing this course, the students will be able to
- Compute the electric circuit parameters for simple problems
- Explain the working principle and applications of electrical machines
- Analyse the characteristics of analog electronic devices
- Explain the basic concepts of digital electronics
- Explain the operating principles of measuring instruments.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

YOUTUBE RESOURCES:

1. **NPTEL - Electrical Engineering**: NPTEL (National Programme on Technology Enhanced Learning) provides video lectures and courses on various subjects, including Electrical Engineering fundamentals.
2. **Learn Engineering**: Learn Engineering offers animated video lectures and tutorials on fundamental concepts in Electrical and Electronics Engineering, including circuits, transformers, machines, and more.

3. **Engineering Funda**: Engineering Funda provides video lectures on basic electrical engineering concepts, circuit analysis, electrical machines, transformers, and power systems.
4. **Electrical Engineering Basics**: This channel covers fundamental topics in Electrical Engineering such as electrical circuits, Ohm's Law, Kirchhoff's Laws, and basic electronics.

<table>
<tr><td>Course Code</td><td rowspan="2">ENGINEERING MECHANICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>ME2201</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

COURSE OBJECTIVES:

- To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- To study and understand the distributed forces, surface, loading on beam and intensity.
- To learn the principles of friction, forces and to determine the apply the concepts of frictional forcesat the contact surfaces of various engineering systems.
- To develop basic dynamics concepts – force, momentum, work and energy

COURSE DESCRIPTION

Engineering Mechanics is a foundational course that introduces students to the principles of mechanics and their application to engineering problems. The course covers topics such as statics, dynamics, kinematics, kinetics, and the behavior of particles and rigid bodies under various forces and constraints. Students will learn how to analyze and solve problems related to equilibrium, motion, and forces in engineering systems.

PREREQUISITES

- Basic knowledge of physics, mathematics (calculus, algebra), and engineering fundamentals is recommended for students enrolling in this course.
- Familiarity with vectors, forces, and basic kinematics concepts will be beneficial.

UNIT I STATICS OF PARTICLES **9**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGIDBODIES **9**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supportsand Connections.

UNIT III DISTRIBUTED FORCES **9**

Centroids of lines and areas — symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three- Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION **9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES **9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Illustrate the vector and scalar representation of forces and moments
- Analyse the rigid body in equilibrium
- Evaluate the properties of distributed forces
- Determine the friction and the effects by the laws of friction
- Calculate dynamic forces exerted in rigid body

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition,Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition,Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7thedition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw HillHigher Education, 2013.

YOUTUBE RESOURCES:

1. Structure free: This channel offers comprehensive tutorials on Engineering Mechanics, covering topics such as statics, dynamics, equilibrium, and forces.

2. Learn Engineering.org: LearnEngineering.org provides animated video lectures and tutorials on various engineering subjects, including Engineering Mechanics.

3. Mechanical Engineering Channel: This channel features lectures and tutorials on Engineering Mechanics, mechanics of materials, and other mechanical engineering topics.

4. Statics The Easy Way: Statics The Easy Way offers explanations and examples related to statics, equilibrium, and force analysis in Engineering Mechanics.

Course Code	ENGINEERING GRAPHICS	L	T	P	C
ME2202		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

COURSE DESCRIPTION

Engineering Graphics is a foundational course that focuses on the principles and techniques of graphical communication in engineering. The course covers topics such as technical drawing, computer-aided design (CAD), geometric construction, dimensioning, and visualization of engineering designs. Students will learn how to create, interpret, and communicate engineering drawings and models using industry-standard methods and software tools.

PREREQUISITES

- Basic knowledge of geometry, technical mathematics, and computer literacy is recommended for students enrolling in this course.
- Familiarity with drawing tools, CAD software, and engineering design concepts will be beneficial.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND FREE HAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACE 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other –– obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids –– Prisms, pyramids cylinders and cones. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection –– isometric scale - lsometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30; P=60) 90 HOURS

OUTCOMES:

On successful completion of this course, the student will be able to

- Use BIS conventions and specifications for engineering drawing.
- Construct the conic curves, involutes and cycloid.
- Solve practical problems involving projection of lines.
- Draw the orthographic, isometric and perspective projections of simple solids.
- Draw the development of simple solids

TEXT BOOK:

1. Bhatt N.D.and Panchal V.M., "Engineering Drawing",Charotar Publishing House rd 53 Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2 nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore,27th Edition,2017.
3. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

YOUTUBE RESOURCES:

1. SolidWorks Tutorials - Tutorial Point: This playlist provides tutorials on using SolidWorks, a popular CAD software, for engineering graphics and design.

2. Engineering Graphics - NPTEL: NPTEL (National Programme on Technology Enhanced Learning) offers video lectures on Engineering Graphics covering topics such as projections, isometric views, sections, and developments.

3. AutoCAD Tutorials - CAD in Black: CAD in Black provides tutorials on using AutoCAD, a widely used CAD software, for creating engineering drawings and graphics.

4. Engineering Graphics - EduMation: EduMation offers tutorials and lectures on Engineering Graphics covering topics such as projections, section views, dimensioning, and tolerancing.

Course Code	FUNDAMENTALS OF C PROGRAMMING	L	T	P	C
CS2211		2	0	2	3

COURSE OBJECTIVES:

- To understand the constructs of C Language.
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop modular applications in C using functions
- To develop applications in C using pointers and structures
- To do input/output and file handling in C

COURSE DESCRIPTION

The Fundamentals of C Programming course is designed to provide students with a solid foundation in computer programming using the C programming language. The course covers essential programming concepts, syntax, data types, control structures, functions, arrays, pointers, and file handling in C. Students will learn how to write, compile, debug, and execute C programs to solve problems, implement algorithms, and develop basic software applications.

PREREQUISITES

There are no specific prerequisites for this course. However, basic computer literacy, logical reasoning skills, and familiarity with algebraic concepts will be beneficial for students

UNIT I BASICS OF C PROGRAMMING 6

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process

UNITII ARRAYS AND STRINGS 6

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS 6

Modular programming – function definition, function call, Function prototype- Parameter passing: Pass by value, Pass by reference – Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers

UNIT IV STRUCTURES AND UNION 6

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

UNIT V FILE PROCESSING 6

Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.

TOTAL: 30 HOURS

EXPERIMENTS:

Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

- I/O statements, operators, expressions
- Decision-making constructs: if-else, goto, switch-case, break-continue
- Loops: for, while, do-while
- Arrays: 1D and 2D, Multi-dimensional arrays, traversal
- Strings: operations
- Functions: call, return, passing parameters by (value, reference), passing arrays to function.
- Recursion
- Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
- Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
- Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 30 HOURS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

- Demonstrate knowledge on C Programming constructs
- Develop simple applications in C using basic constructs
- Design and implement applications using arrays and strings
- Develop and implement modular applications in C using functions.
- Develop applications in C using structures and pointers.
- Design applications using sequential and random access file processing.

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.

YOUTUBE RESOURCES:

1. The New Boston - C Programming Tutorials: This playlist covers a wide range of topics in C programming, starting from basics to more advanced concepts.

2. Programming Knowledge - C Programming Tutorial for Beginners: This series provides beginner-friendly tutorials on C programming, covering syntax, data types, control structures, functions, and arrays.

3. Code With Harry - C Programming Playlist: Code With Harry offers a comprehensive playlist on C programming with easy-to-understand explanations and practical examples.

4. Derek Banas - C Programming Tutorial: Derek Banas provides a concise tutorial series

Course Code	COMMUNICATIVE ENGLISH II	L	T	P	C
HS2201		2	0	2	3

COURSE OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions ina professional context.
- To be able to communicate effectively through writing.

COURSE DESCRIPTION

Communicative Higher English is an advanced-level course designed to enhance students' proficiency in the English language, focusing on advanced communication skills, critical analysis, and literary appreciation. The course emphasizes practical application of language skills in various contexts, including academic writing, public speaking, debates, and literary analysis. Students will engage with a wide range of texts, both literary and non-literary, to develop analytical thinking, language fluency, and communication strategies.

PREREQUISITES

- This course is suitable for students with an intermediate to advanced level of English proficiency.
- A strong foundation in grammar, vocabulary, reading comprehension, and basic writing is recommended.

UNIT I **12**

Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition-discussing progress toward goals-talking about experiences- talking about events in life-discussing past events- Writing: writing emails (formal & semi-formal).

UNIT II **12**

Speaking: discussing news stories-talking about frequency-talking about travel problems-discussing travel procedures- talking about travel problems- making arrangements-describing arrangements- discussing plans and decisions- discussing purposes and reasons- understanding common technologyterms-Writing: - writing different types of emails.

UNIT III **12**

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages- making comparisons-discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.

UNIT IV **12**

Speaking: discussing the natural environment-describing systems-describing position and movement- explaining rules-(example- discussing rental arrangements)- understanding technical instructions- Writing: writing instructions-writing a short article.

UNIT V **12**

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 HOURS

COURSE OUTCOMES

- Speak effectively in group discussions held in a formal/semi formal contexts.
- Write emails and effective job applications.

ASSESSMENT PATTERN

- One online / app based assessment to test speaking and writing skills
- Proficiency certification is given on successful completion of speaking and writing.

YOUTUBE RESOURCES:

1. TED-Ed: TED-Ed offers a wide range of videos on communication skills, public speaking, storytelling, and critical thinking, which are all relevant to higher English communication.

2. BBC Learning English: speaking, listening, BBC Learning English provides videos and resources focused on improving English language skills, including vocabulary, and pronunciation.

3. Rachel's English: Rachel's English is a channel dedicated to helping learners improve their American English pronunciation, intonation, and speaking skills.

4. English Lessons 4U - Learn English with Ronnie! [engVid]: Ronnie from engVid offers lessons on English communication, grammar, vocabulary, idioms, and expressions to enhance language fluency.

Course Code	ENGINEERING PRACTICES LABORATORY	L	T	P	C
ME2203		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

• Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.

• Wiring various electrical joints in common household electrical wire work.

• Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.

• Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

COURSE DESCRIPTION

Engineering Practices Laboratory is a hands-on course designed to introduce students to fundamental engineering principles, techniques, tools, and practices commonly used in various engineering disciplines. The course aims to develop students' practical skills, problem-solving abilities, teamwork, and safety awareness in a laboratory environment. Students will engage in experiments, projects, and exercises related to engineering measurements, data analysis, instrumentation, and technical documentation.

PREREQUISITES

- Basic knowledge of engineering concepts, mathematics, and physics is recommended for students enrolling in this course.
- Familiarity with basic engineering tools, instruments, and computer applications will be beneficial.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES **15**

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

b)Preparing plumbing line sketches.

c) Laying pipe connection to the suction side of a pump

d) Laying pipe connection to the delivery side of a pump.

e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in house hold appliances.

WOOD WORK:

a) Sawing,

b) Planing and

c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture

b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket

b) Staircase wiring

c) Fluorescent Lamp wiring with introduction to CFL and LED types.

d) Energy meter wiring and related calculations/ calibration

e) Study of Iron Box wiring and assembly

f) Study of Fan Regulator (Resistor type and Electronic type using Diac/ Triac/ quadrac)

g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.

b) (simple)Drilling.

c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.

b) Assembling a household mixer.

c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an elements of smart phone.

b) Assembly and dismantle of LED TV.

c) Assembly and dismantle of computer/ laptop

TOTAL : 60 HOURS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
- Wire various electrical joints in common household electrical wire work.
- Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipment's; Make a tray out of metal sheet using sheet metal work.
- Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

YOUTUBE RESOURCES:

1. "Civil Engineering Lab Experiments" by Civil Engineering Experiments: This channel provides videos demonstrating various civil engineering lab experiments covering topics like soil mechanics, concrete technology, and material testing.

2. "Civil Engineering Lab Videos" by CEVOLAB - Civil Engineering Laboratory: CEVOLAB offers a series of videos showcasing civil engineering lab activities, experiments, and procedures related to structural analysis, geotechnical engineering, and environmental engineering.

3. Mechanical Engineering Lab Experiments" by Mechanical Engineering Labs: This channel features videos demonstrating mechanical engineering lab experiments, including fluid mechanics, thermodynamics, strength of materials, and machine testing.

4. Mechanical Engineering Workshop Videos" by MechEng Tutorials: MechEng Tutorials offers videos on mechanical engineering workshop practices, tool handling, equipment usage, and safety precautions commonly observed in mechanical engineering labs.

5. Electrical Engineering Lab Demonstrations" by Electrical Engineering Hub: This channel provides demonstrations of electrical engineering lab experiments and practical demonstrations related to circuits, electronics, electrical machines, and power systems.

6. Electrical Engineering Lab Videos" by EE LAB: EE LAB offers videos covering electrical engineering laboratory procedures, measurements, instrumentation, and experiments focusing on circuits, controls, and power electronics.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – II	L	T	P	C
ES2201		0	0	2	1

COURSE OBJECTIVES

1. To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
2. To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
3. To critically evaluate numerous possibilities related to puzzles.

COURSE DESCRIPTION

Employability Enhancement Skills is a comprehensive course designed to equip students with the essential skills, knowledge, and attitudes required for success in the modern workplace. The course focuses on developing professional competencies, interpersonal skills, career readiness, and adaptability to meet the demands of diverse industries and job roles. Through interactive learning experiences and practical exercises, students will enhance their employability, career prospects, and personal development.

PREREQUISITES

- There are no specific prerequisites for this course.
- However, students are encouraged to have a positive attitude, willingness to learn, and openness to self-improvement.

UNIT I – TIME AND DISTANCE **6**

Introduction – Speed: Late / Early / Usual Time – Average Speed – Chasing – Problems on Train: Crossing Pole, Crossing Platform, Train moving in same and different direction – Boats and Streams: Upstream, Downstream – Clock – Calendar.

UNIT II – PROBABILITY AND STATISTICS **6**

Introduction – Algebra of Events – Addition theorem of Probability – Permutation and Combinations – Problems based on choosing the objects – Statistics: Range – frequency, Arithmetic Mean – Median – Mode – Variance – Standard Deviation – Measures of Dispersion – Coefficient of Variation.

UNIT III – ARITHMETIC AND LOGICAL REASONING **6**

Introduction – Mathematical Operations – Blood Relations: Direct, Indirect, coded – Problems on Cubes and Dices: Face identification – Folding and cutting Images – Counting technique of figures – Distance & Direction

UNIT IV – APPLIED MATHEMATICS **6**

Mensuration (2D&3D): Square, Rectangle, Triangle, Circle, Parallelogram, Rhombus, Trapezoid, Quadrilateral, Cube, Cuboid, Cylinder, Cone, Sphere, Miscellaneous – Trigonometry: Ratio, Identities, Heights and Distances – Algebra – Logarithm – Geometry.

UNIT V – VERBAL AND LOGICAL REASONING **6**

Introduction – Venn diagram – Syllogism – Data Sufficiency – Decision Making – Puzzle: Number Puzzle, Letter Puzzle – Ranking Test – Data Arrangement: Linear, Circular, Miscellaneous – Critical Reasoning.

TOTAL: 30 HOURS

COURSE OUTCOMES

After the completion of the course, students will be able to

- Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests.
- Solve questions related to Time etc. from company specific and other competitive tests.
- Illustrate and solve puzzle related questions from specific and other competitive tests

TEXT BOOKS:

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES:

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

YOUTUBE RESOURCES:

1. Explore Career Development Channels: Look for YouTube channels dedicated to career development, professional skills, and personal growth. Channels like TEDx Talks, Brian Tracy, CareerVidz, and CareerBuilder offer valuable insights and tips.

2. University and Institution Channels: Many universities and educational institutions upload videos related to employability skills, career workshops, interview preparation sessions, and soft skills training. Explore channels from universities known for their career services.

3. Career Coaches and Experts: Search for videos from career coaches, HR professionals, industry experts, and motivational speakers who share tips, strategies, and advice on enhancing employability skills.

4. Online Learning Platforms: Platforms like Coursera, LinkedIn Learning, Udemy, and Skill share often have free or paid courses on employability skills. Some of them also share introductory videos or excerpts from their courses on YouTube.

Course Code	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
MA2301		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier, transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

COURSE DESCRIPTION

Transforms and Partial Differential Equations is a foundational course designed to introduce students to mathematical techniques used in engineering and scientific applications. The course covers the theory and application of integral transforms such as Laplace, Fourier, and Z-transforms, as well as methods for solving partial differential equations (PDEs). Students will learn how to apply these mathematical tools to analyze and solve problems in various fields, including electrical engineering, mechanical engineering, physics, and applied mathematics.

PREREQUISITES

- Basic knowledge of calculus, differential equations, linear algebra, and mathematical modelling
- Familiarity with engineering applications and problem-solving techniques.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types- Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series andcosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Fourier series solutions of one-dimensional wave equation — One dimensional equation of heat conduction — Steady state solution of two- dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem– Fourier transform pair —Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval'sidentity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Convergence of Z-transforms - – Initial and final value theorems Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations Solution of difference equations using Z - transforms.

TOTAL: 60 HOURS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineeringapplications.
- Appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Ztransform techniques for discrete time systems

TEXT BOOKS:

1. Erwin E., "Advanced Engineering Mathematics",John Wiley and Sons (Asia) Limited, Hoboken,2020.
2. Grewal. B.S, "Higher Engineering Mathematics", 44th edition, Khanna Publications, Delhi, 2018.
3. Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers,6th edition, 2016.

REFERENCE BOOKS:

1. Veerarajan. T, "Transforms and Partial differential equations", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., reprint, 2016.
2. N.P.Bali ,"A Text book of Engineering Mathematics Sem-III/IV" 13th edition, LaxmiPublications ltd, 2017.
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2016.
4. P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Numerical Methods",S.Chand Co. Ltd., New Delhi, 2015.
5. Holly Moore, "MATLAB for Engineers" Fifth Edition – Pearson Publications,2018.

WEB REFERENCES:

- https://www.youtube.com/watch?v=jNC0jxb0OxE

- https://www.youtube.com/watch?v=iRXXmtcocAQ
- https://www.youtube.com/watch?v=OGT59INHz3Y

ONLINE RESOURCES:

- https://nptel.ac.in/courses/111/106/111106111/
- https://nptel.ac.in/courses/111/107/111107111/
- https://nptel.ac.in/courses/111/107/111107107/

YOUTUBE RESOURCES:

1**. MIT OpenCourseWare (OCW):** MIT OCW offers lectures and course materials on various topics including Transforms and PDEs. You can find full course videos, lecture notes, and assignments.

2. Khan Academy: Khan Academy has videos on differential equations, including topics on Fourier series and Laplace transforms. These videos cover the basics and are great for building a foundation.

3. The Math Sorcerer: The Math Sorcerer channel provides tutorials on transforms, Fourier series, Laplace transforms, and solving differential equations. The videos are clear and well-explained.

4. Dr. Chris Tisdell: Dr. Chris Tisdell's channel covers various topics in mathematics, including videos on transforms, Fourier series, and solving PDEs. The explanations are detailed and easy to follow.

Course Code	ENGINEERING THERMODYNAMICS	L	T	P	C
ME2301		3	0	0	3

COURSE OBJECTIVES:

- Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.
- Impart knowledge on availability and applications of second law of thermodynamics
- Teach the various properties of steam through steamtables and Mollier chart.
- Impart knowledge on the macroscopic properties of ideal and real gases.

COURSE DESCRIPTION

Engineering Thermodynamics is a fundamental course that introduces students to the principles and concepts governing energy transfer and thermodynamic systems in engineering applications. The course covers topics such as energy conservation, heat transfer, work interactions, properties of substances, and thermodynamic cycles. Students will learn how to apply thermodynamic principles to analyze and solve problems related to heat engines, refrigeration systems, power generation, and energy conversion processes.

PREREQUISITES

- Basic knowledge of physics, calculus, and introductory engineering principles is recommended.
- Familiarity with mathematical modeling, energy concepts, and material properties will be beneficial for understanding thermodynamic principles.

UNIT I BASICS, ZEROTH AND FIRST LAW 9

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium -Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNITII SECOND LAW AND ENTROPY 9

Heat Engine—Refrigerator-Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram – Tds Equations-Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High-and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT IV PROPERTIES OF PURE SUBSTANCES 9

Steam- formation and its thermodynamic properties -p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states – Generalized Compressibility Chart. Maxwell relations- TdS Equations- heat capacities relations- Energy equation, Joule-Thomson experiment-Clausius-Clapeyron equation.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
- Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
- Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
- Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
- Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXTBOOKS:

1. Nag.P.K.,“ Engineering Thermodynamics”, 6thEdition,Tata McGrawHill (2017), New Delhi.
2. Natarajan,E., “Engineering Thermodynamics: Fundamentals and Applications”, 2ndEdition(2014), Anuragam Publications, Chennai.

REFERENCES:

1. Cengel,Y and M.Boles, Thermodynamics-An Engineering Approach, Tata McGraw Hill, 9thEdition,2019.
2. Chattopadhyay,P, “Engineering Thermodynamics”,2nd Edition Oxford University Press,2016
3. Rathakrishnan, E., “Fundamentals of Engineering Thermodynamics”, 2nd Edition, Prentice Hall of IndiaPvt.Ltd,2006.
4. Claus Borgnakke and Richard E.Sonntag, “Fundamentals of Thermodynamics”, 10th Edition,WileyEastern,2019.
5. Venkatesh.A, “Basic Engineering Thermodynamics”, Universities Press (India) Limited,2007

WEB REFERENCES:

- http://nptel.ac.in/courses/112103016/
- http://nptel.ac.in/courses/112105128/

ONLINE RESOURCES:

http://booksite.elsevier.com/balmer/thermodynamicresources.php

YOUTUBE RESOURCES:

1. Learn ChemE (University of Colorado Boulder): This channel offers a series of videos covering various topics in thermodynamics, including properties of substances, energy transfer, and thermodynamic cycles.

2. The Organic Chemistry Tutor: The channel provides tutorials on engineering thermodynamics concepts, laws, calculations, and problem-solving techniques.

3. Engineering Academy: Engineering Academy offers videos on thermodynamics topics, including the first law of thermodynamics, heat transfer, thermodynamic cycles, and more.

4. Jeff Hanson - Engineering Courses: The channel provides lectures and tutorials on engineering thermodynamics, covering fundamental concepts and applications.

Course Code	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
EE2301		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

COURSE DESCRIPTION

Electrical Drives and Controls is a specialized course focusing on the principles, components, and control methods used in electric drive systems. The course covers topics related to the operation, analysis, design, and control of electrical machines and drives commonly used in industrial, automotive, and robotics applications. Students will learn about various types of electric drives, control strategies, power electronics, motor characteristics, and performance analysis techniques.

PREREQUISITES

- Basic knowledge of electrical circuits, electromechanical systems, power systems, and control theory.
- Familiarity with electric motors, power electronics, and mathematical modeling of dynamic systems

UNIT I: INTRODUCTION 8

Basic Elements–Types of Electric Drives–factors influencing the choice of electrical drive heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal over loading and Load variation factors

UNIT II: DRIVE MOTOR CHARACTERISTICS 9

Mechanical characteristics–Speed-Torque characteristics of various types of load and drive motors Braking of Electrical motors—DC motors: Shunt, series and compound single phase and three phase induction motors.

UNIT III: STARTING METHODS 8

Types of D.C Motor starters–Typical control circuits for shunt and series motors–Three phase squirrel cage and slip ring induction motors.

UNIT IV: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C.DRIVES 10

Speed control of DC series and shunt motors –Armature and field control, Ward-Leonard control system-Using controlled rectifiers and DC choppers– applications.

UNIT V: CONVENTIONAL AND SOLID STATE SPEED CONTROL OFA.C. DRIVES 10

Speed control of three phase induction motor– Voltage control, voltage/ frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TOTAL: 45 HOURS

COURSE OUTCOME:

- Upon Completion of this subject, the students can able to explain different types of electrical machines and their performance

TEXTBOOKS:

1. Nagrath.I.J. & Kothari.D.P, "Electrical Machines" ,Tata McGraw-Hill,2006
2. Vedam Subrahmaniam, "Electric Drives(Concepts and Applications)", Tata McGraw-Hill,2010

REFERENCES:

1. Partab.H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited,2012
3. Singh.M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw Hill, 2006

YOUTUBE RESOURCES:

1. Electrical Engineering - Khan Academy: This channel offers videos covering electrical engineering topics, including electric motors, drives, and controls.

2. LearnEngineering.org: LearnEngineering.org provides comprehensive videos on electrical machines, drives, power electronics, and control systems.

3. NPTEL - Electrical Engineering: NPTEL offers video lectures by professors from IITs and other institutions on electrical drives, motors, and control systems.

4. Engineering Academy: Engineering Academy provides tutorials and explanations on electric drives, control systems, and motor operation.

Course Code	HERITAGE OF TAMILS	L	T	P	C
HS2301		1	0	0	1

COURSE DESCRIPTION

Explore the origins and development of ancient Tamil civilization, including the Sangam period, classical literature (Sangam literature), political systems, social structures, trade, and cultural exchanges. Discuss the significance of the Tamil language as one of the oldest classical languages in the world, and explore major works of Tamil literature, poets, playwrights, and literary movements.

PREREQUISITES

• A genuine interest in Tamil culture, history, language, literature, arts, and traditions is crucial for engaging with the subject matter and appreciating the depth and richness of Tamil heritage.

• Familiarity with general historical concepts, timelines, historical periods, and key events can provide a foundation for understanding the historical context of Tamil heritage and civilization.

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE – ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self – Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL (THEORY):15 HOURS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in

print)

2. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL).

YOUTUBE RESOURCES:

1. **Tamil Heritage Foundation:** This channel focuses on Tamil heritage, history, culture, and arts, featuring documentaries, lectures, interviews, and discussions related to Tamil heritage and civilization.

2. **Madras Heritage and Carnatic Music:** This channel explores the heritage of Chennai (formerly Madras), including historical sites, architecture, cultural events, Carnatic music, and traditional arts of Tamil Nadu.

3. **Tamil Heritage Trust:** The Tamil Heritage Trust channel features videos on Tamil heritage, archaeological discoveries, heritage conservation, temple architecture, and cultural heritage initiatives.

4. **Vanam Tamil Arts & Culture:** This channel focuses on Tamil arts, culture, literature, folk traditions, dance forms, music, storytelling, and cultural events celebrating Tamil heritage.

5. **Chennai Heritage:** Chennai Heritage offers videos on the heritage of Chennai city, historical landmarks, monuments, heritage walks, cultural festivals, and stories of the city's past

Course Code	FLUID MECHANICS AND MACHINERY	L	T	P	C
ME2302		3	0	2	4

COURSE OBJECTIVES:

- To understand the properties of the fluid
- To analyze and appreciate the complexities involved in solving the fluid flow problems.
- To study the mathematical techniques and apply them to the solutions of practical flow Problems
- Learn to apply conservation laws flow through pipes.

COURSE DESCRIPTION

Fluid Mechanics and Machinery is a comprehensive course that introduces students to the fundamental principles of fluid mechanics and the operation of various fluid machinery used in engineering applications. The course covers topics such as fluid properties, fluid statics, fluid dynamics, flow measurements, hydraulic machinery, pumps, turbines, and their practical applications. The laboratory component provides hands-on experience with experimental setups, flow measurements, performance testing of pumps and turbines, and analysis of fluid behavior.

PREREQUISITES

- Basic knowledge of physics, calculus, and engineering mechanics
- Familiarity with fundamental concepts in fluid mechanics such as pressure, flow, and forces exerted by fluids

UNIT I BASIC CONCEPTS AND FLUID PROPERTIES 10

Density, specific weight, specific volume, specific gravity, viscosity, compressibility, capillary, surface tension and buoyancy - forces on submerged bodies, Measurement of Pressure: Pascal’s law and Hydrostatic equation - concept of fluid static pressure, Measurement of Pressure using Manometers.

UNIT II FLUID DYNAMICS 10

Euler's equation - Bernoulli's equation and its applications. Laminar flow – Hagan Poiseuille equation - Turbulent flow – Darcy Weisbach formula - Major and minor losses of flow in circular pipes. Pipes in series and in parallel. Boundary Layer - Boundary layer thickness, boundary layer separation

UNIT III DIMENSIONAL ANALYSIS 10

Dimension and Units – Buckingham π theorem – similitude – Dimensionless numbers - Model analysis. Centrifugal pumps, Reciprocating pump – working principles, Velocity triangles, Work done by impellor, Efficiencies, Cavitation in pumps. Classification of water turbines - Pelton wheel, Francis turbine and Kaplan turbines, working principles - Constructional details, Velocity triangles, Power and efficiency calculations - Specific speed.

TOTAL (THEROY): 30 HOURS

AB EXERCISES

1. Determination of coefficient of discharge of a venturimeter

2. Determination of friction factor for flow through pipes
3. Determination of metacentric height
4. Determination of forces due to impact of jet on a fixed plate
5. Characteristics of centrifugal pumps
6. Characteristics of reciprocating pump
7. Characteristics of Pelton wheel turbine

TOTAL (LAB): 30 HOURS
TOTAL: (30+30) 60 HOURS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

- Recognize the basic concepts of fluid properties.
- Examine the fluid flow and its behaviour.
- Study the behaviour of boundary layer flows.
- Examine the dependent and independent dimensionless parameters.
- Analyze the performance of hydraulic machines.

TEXT BOOKS:

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill Education, 2017.
2. Rajput, R.K., "Fluid Mechanics and Hydraulic Machines", S.Chand Publishers,
3. 2016.
4. Yunus Cengel and John Cimbala, Fluid Mechanics Fundamentals and Application,
5. Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi 2010.

REFERENCE BOOKS:

1. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd. New Delhi 2016
2. Bansal, R.K. "Fluid Mechanics and hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi,2018
3. Introduction to Fluid Mechanics, Robert W. Fax, Philip J. Pritchard, Alan T. McDonald. Wiley India Edition. (Wiley Student Edition Seventh 2011).

WEB REFERENCES:

- http://www.nptel.ac.in
- http://www.creativeworld9.com

ONLINE RESOURCES:

- https://www.reddit.com/r/fluid_mechanics_online_andor_textbook_resources
- www.efluids.com

YOUTUBE RESOURCES:

1. Learn ChemE (University of Colorado Boulder): This channel covers various topics in chemical engineering, including fluid mechanics and related experiments.

2. NPTEL - Mechanical Engineering: NPTEL offers lectures by professors from IITs and other institutions on fluid mechanics and machinery, including lab demonstrations.

3. The Organic Chemistry Tutor: This channel provides tutorials on fluid mechanics topics, equations, and problem-solving techniques.

4. Engineering Academy: Engineering Academy offers videos on fluid mechanics concepts, laboratory experiments, and machinery operation.

5. Dr. Chirag Patel: Dr. Chirag Patel's channel covers fluid mechanics lectures, demonstrations, and practical aspects of fluid machinery.

Course Code	MANUFACTURING TECHNOLOGY	L	T	P	C
ME2303		3	0	2	4

COURSE OBJECTIVES:

- To understand the concepts of metal cutting and measurements.
- To understand the working of standard machine tools, special purpose machines and allied machining processes.
- To study the advancements in manufacturing operations.

COURSE DESCRIPTION

Manufacturing Technology is a multidisciplinary course that introduces students to various manufacturing processes, techniques, and technologies used in industrial production. The course covers topics related to material properties, machining methods, casting, forming, welding, additive manufacturing, automation, and quality control in manufacturing. The laboratory component provides hands-on experience with manufacturing equipment, tools, processes, and quality assessment techniques.

PREREQUISITES

- Basic knowledge of materials science, engineering fundamentals, and manufacturing processes
- Familiarity with engineering drawings, measurement tools, and workshop practices

UNIT I: THEORY OF METAL CUTTING: 10

Introduction, cutting tool: Types, materials and life. Theory of metal cutting: Merchant's circle, cutting force measurements - Chip formation. Centre Lathe: Constructional features, various operations, work holding devices and machining time estimation. Capstan and turret lathes – Automats: Single and Multi-spindle.

UNIT II: SPECIAL PURPOSE MACHINES AND ABRASIVE PROCESSES: 10

Shaper, Planer, Slotter machines. Milling machines: Types, cutters and various operations. Drilling machines: Types, Operations. Broaching - Gear cutting: forming, generation, shaping, Grinding Process: Introduction, types of grinding processes - Finishing processes: Honing, lapping, super finishing, polishing and buffing.

UNIT III: ADVANCED MANUFACTURING METHODS: 10

Abrasive Jet machining (AJM), Ultrasonic machining (USM), Electro chemical machining (ECM), Electrical discharge machining (EDM), Electron beam machining (EBM) and Laser beam machining (LBM). Additive Manufacturing processes: Direct Metal Laser Sintering (DMLS) - Direct Metal Laser Melting (DMLM) - Electron Beam Melting (EBM) - Stereolithography (SLA) – Applications. CNC machines: Introduction, machine structure and drives, feedback devices, Automatic tool changers and multiple pallet systems, MT Connect, Industrial Internet of CNC Machines, DIY Hardware and Part programming fundamentals.

LAB EXERCISES

1. Taper turning and external thread cutting using lathe
2. Measuring various angles involved in a single point cutting tool

3. Measurement of cutting forces in Turning / Milling process
4. Contour milling and keyway slotting
5. Fasten the two different plates using drilling, reaming and tapping processes
6. External dovetail and internal dovetail
7. Make a spur gear / helical gear using hobbing machine.
8. Improve the surface finish of the given component using grinding process
9. Perform a machining operation using CNC turning centre.
10. Estimate the cycle timing of the machining operation
11. Every student must undergo minimum of 3 industrial visits during the activity day.

TOTAL (THEORY): 30 HOURS

TOTAL (LAB): 30 HOURS

TOTAL: (30+30) 60 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Understand the basics of metal cutting processes and various machining operations.
- Discuss the working principle of special purpose machines and various mechanisms involved.
- Categorize the various finishing operations and advanced manufacturing methods.
- Understand the working of CNC machine tools and different additive manufacturing techniques.
- Make components using various manufacturing processes and analyze their machining time.

TEXT BOOKS:

1. Serope Kalpakjian, "Manufacturing Engineering and Technology", Pearson India, 7th edition. 2018
2. Rao, P.N. "Manufacturing Technology - Metal Cutting and Machine Tools," McGraw – Hill Education, New Delhi, 2013.

REFERENCE BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promotors Pvt Ltd., 2014.
2. HMT - "Production Technology", McGraw-Hill Education, 2017.

WEB REFERENCES:

- https://nptel.ac.in/courses/112105127/
- www.sme.org

ONLINE RESOURCES:

- https://ocw.mit.edu/courses

YOUTUBE RESOURCES:

1. Learn Engineering: This channel offers videos on various aspects of manufacturing technology, including machining, casting, welding, and more.

2. NPTEL - Mechanical Engineering (Manufacturing Processes I and II): NPTEL provides comprehensive lectures on manufacturing processes, materials, and technologies in two parts.

3. MIT Open Course Ware - Mechanical Engineering: MIT's Open Course Ware platform offers lectures and course materials on manufacturing processes, materials selection, and industrial applications.

4. Engineering Academy: Engineering Academy covers topics such as machining, CNC technology, additive manufacturing, and quality control in manufacturing.

Course Code	SOLID MECHANICS	L	T	P	C
ME2304		3	0	2	4

COURSE OBJECTIVES:

- To learn the fundamental concepts of strength of materials
- To understand and analyze the stress induced in various structural members
- To evaluate the stability of columns and beams.
- To understand the two dimensional stresses.

COURSE DESCRIPTION

Solid Mechanics is a foundational course in engineering that focuses on the behavior of solid materials under various loading conditions. The course covers topics related to stress, strain, deformation, material properties, elasticity, plasticity, failure theories, and structural analysis. The laboratory component provides hands-on experience with experimental setups, testing procedures, data collection, and analysis of solid mechanics principles.

PREREQUISITES

- Basic knowledge of physics, mathematics (calculus, differential equations), and engineering fundamentals.
- Familiarity with mechanics of materials, statics, and dynamics.

UNIT I: SIMPLE STRESSES AND STRAIN- 10

Introduction, Definition, Hooke's law, Stress-Strain diagrams, factor of safety, Elongation due to self-weight, Compound bars, Thermal stresses, Compound section subjected to thermal stresses. Elastic constants and their relationships. Principal stresses and principal planes- Mohr's circle. Strain Energy- Analysis of strain energy in uniaxial loading.

UNIT II: INTRODUCTION TO TYPES OF BEAMS 10

supports and loadings. Definition of bending moment and shear force, Sign conventions, Shear force and bending moment diagrams for statically determinate beams subjected various kinds of loads. Stresses in Beams- bending equation, section modulus, flexural rigidity. Analysis of bending stress in the circular, rectangular, 'I' sections. Deflection of Beams - Double Integration method and Macaulay's method.

UNIT III: TORSION 10

Stresses and deformation in circular and hollow shafts, torsional rigidity and polar modulus, Power transmitted by a uniform shaft, Columns – Buckling load by Euler's and Rankine's equations. Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thin and thick cylinders subjected to internal pressure.

TOTAL (THEORY): 30 HOURS

LAB EXERCISES

1. Double shear test on Mild steel and Aluminum rods
2. Torsion test on mild steel rod
3. Impact test on metal specimen

4. Hardness test on metals – Brinnell and Rockwell Hardness Number
5. Deflection test on beams
6. Compression test on helical springs
7. Strain Measurement using Rosette strain gauge

TOTAL (LAB): 30 HOURS
TOTAL: (30+30) 60 HOURS

TEXT BOOKS:

1. Ferdinand P. Beer , E. Russell Johnston Jr, John T. DeWolf , David F. Mazurek ,

2. Sanjeev Sanghi , ""Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 8th Edition , 2020

3. S.S. Rattan "Strength of Materials", McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2017.

REFERENCE BOOKS:

1. Egor.Popov , "Mechanics of Materials" 2nd Edition, Pearson Education India, 2015
2. S. H. Crandall and N. C. Dahl, "Introduction to Mechanics of Solids", 3rd Edition, Tata McGraw Hill, India, 2013.
3. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2018.

WEB REFERENCES:

- https://lecturenotes.in/subject/260/strength-of-materials-som

ONLINE RESOURCES:

- https://nptel.ac.in/courses/112107146

YOUTUBE RESOURCES:

1. StructureFree: This channel provides in-depth tutorials and lectures on structural engineering topics, including solid mechanics.

2. Mechanical Engineering by Engineering Funda: The Engineering Funda channel covers various topics in mechanical engineering, including solid mechanics principles and applications.

3. StructureFree: Another playlist from StructureFree focusing on structural analysis and mechanics of materials.

4. NPTEL - Mechanical Engineering (Solid Mechanics): NPTEL offers video lectures by professors from IITs and other institutions covering solid mechanics topics

Course Code	INTRODUCTION TO AIML	L	T	P	C
CS2407		3	0	0	3

OBJECTIVES:

- Acquire advanced Data Analysis skills.
- Stay Industry relevant and grow in your career.
- Create AI/ML solutions for various business problems.
- Build and deploy production grade AI/ML applications.
- Apply AI/ML methods, techniques and tools immediate.

COURSE DESCRIPTION

Introduction to AIML is a foundational course that introduces students to the principles, techniques, and applications of artificial intelligence (AI) and machine learning (ML). The course covers topics such as AI concepts, ML algorithms, data preprocessing, model training, evaluation, and practical AI applications. Students will learn about supervised learning, unsupervised learning, reinforcement learning, neural networks, and the ethical implications of AI/ML technologies.

PREREQUISITES

- Basic programming skills in a language like Python or Java.
- Understanding of mathematical concepts such as linear algebra, calculus, probability, and statistics
- Familiarity with data analysis and visualization tools (e.g., NumPy, Pandas, Matplotlib)

UNIT I INTRODUCTION TO DATA SCIENCE AND AI **9**

Data Science, AI & ML Use Cases in Business and Scope -Scientific Method - Modeling Concepts - CRISP-DM Method- Commands and Syntax- Packages and Libraries - Introduction to Data Types - Data Structures in R - Vectors, Matrices, Arrays, Lists, Factors, Data Frames - Importing and Exporting Data. - Control structures and Functions

UNIT II STATISTICAL ANALYSIS AND DATA ACQUISITION **9**

Relationship between attributes: Covariance, Correlation Coefficient, Chi Square - Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs Gather information from different sources. -Internal systems and External systems. - Web APIs, Open Data Sources, Data APIs, Web Scrapping- Relational Database access (queries) to process/access data. Data Pre-processing and Preparation -Data Quality and Transformation Handling Text Data

UNIT III PRINCIPLES OF BIG DATA **9**

Introduction to Big Data - Challenges of processing Big Data (Volume, Velocity and Variety perspective) - Processing, Storage and Programming Framework - Hadoop eco-system Components and their functions - Essential Algorithms (Word count, Page Rank, IT-IDF) - Spark: RDDs, Streaming and Spark ML - NoSQL concepts (CAP, ACID, NoSQL types)

UNIT IV FOUNDATIONS FOR ML **9**

ML Techniques overview Ÿ Validation Techniques (Cross-Validations) Ÿ Feature Reduction/Dimensionality reduction Ÿ Principal components analysis (Eigen values, Eigen vectors, Orthogonality) – Clustering – Classification

UNIT V CLASSIFIERS 9

Naïve Bayes Classifier - Model Assumptions, Probability estimation - Required data processing - M-estimates, Feature selection: Mutual information - Classifier K-Nearest Neighbours - Computational geometry; Voronoi Diagrams; Delaunay Triangulations - K-Nearest Neighbour algorithm; Wilson editing and triangulations -Aspects to consider while designing K-Nearest Neighbour Support Vector Machines - Linear learning machines and Kernel space, Making Kernels and working in feature space - SVM for classification and regression problems. Decision Trees - ID4, C4.5, CART Ensembles methods - Bagging & boosting and its impact on bias and variance - C5.0 boosting - Random forest - Gradient Boosting Machines and XG Boost

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

- Understand advanced Data Analysis skills.
- Have Industry relevant knowledge in AI & ML to for career growth.
- Provide AI/ML solutions for various business problems.
- Build and analyse production related AI/ML applications.
- Apply AI/ML methods, techniques and tools in real time applications

TEXT BOOKS:

1. Tom M Mitchell, "Machine Lerning",1st Edition, McGraw Hill Education, 2017.
2. Elaine Rich, Kevin K and S B Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

- Ameet V Joshi, "Machine Learning and Artificial Intelligence", Springer Cham, 2019.
- Drew Conway, John Myles White "Machine Learning for Hackers", O'Reilly Media, Inc, 2012.

YOUTUBE RESOURCES:

1. sentdex - Machine Learning with Python tutorials: This channel offers a comprehensive series of tutorials covering various aspects of machine learning using Python.

2. edureka! - Machine Learning Full Course for Beginners: Edureka provides a full course on machine learning for beginners, covering fundamental concepts and practical implementations.

3. The Coding Train - Introduction to Machine Learning with TensorFlow.js: The Coding Train channel introduces machine learning concepts using TensorFlow.js, suitable for beginners and those interested in JavaScript-based ML.

4. Krish Naik - Machine Learning Tutorials for Beginners: Krish Naik's channel offers tutorials covering a wide range of machine learning topics for beginners, including hands-on examples and projects.

5. 3Blue1Brown - Neural Networks series: This channel provides a visually engaging series on neural networks, a fundamental concept in machine learning.

Course Code	HYDRAULICS AND PNEUMATICS	L	T	P	C
ME2401		3	0	0	3

COURSE OBJECTIVES

- To provide the knowledge on the working principles of fluid power systems.
- To study the fluids and components used in modern industrial fluid power system.
- To develop the design, construction and operation of fluid power circuits.
- To learn the working principles of pneumatic power system and its components.
- To provide the knowledge of trouble shooting methods in fluid power systems.

COURSE DESCRIPTION

Hydraulics and Pneumatics is a foundational engineering course that introduces students to the principles, components, and applications of fluid power systems. The course covers topics related to hydraulic and pneumatic systems, including fluid properties, pumps, valves, actuators, circuits, and control mechanisms. Students learn about fluid power transmission, energy conversion, system design, troubleshooting, maintenance, and safety aspects of hydraulic and pneumatic systems.

PREREQUISITES

- Basic knowledge of physics, mechanics, and engineering principles
- Familiarity with fluid mechanics concepts (e.g., pressure, flow, energy, Bernoulli's equation)
- Understanding of mechanical systems, components, and terminology

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory-– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders — Types and construction, Application, Hydraulic cushioning — Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Apply the working principles of fluid power systems and hydraulic pumps.
- Apply the working principles of hydraulic actuators and control components.
- Design and develop hydraulic circuits and systems.
- Apply the working principles of pneumatic circuits and power system and its components.
- Identify various troubles shooting methods in fluid power systems.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. James A. Sullivan, "Fluid Power Theory and Applications", Fourth Edition, Prentice Hall, 1997

REFERENCES:

1. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2015.
2. Joshi.P., Pneumatic Control", Wiley India, 2008.
3. Majumdar, S.R., "Oil Hydraulics Systems – Principles and Maintenance",TataMcGraw Hill, 2001.
4. Shanmugasundaram.K., "Hydraulic and Pneumatic Controls". Chand & Co, 2006.
5. Srinivasan.R., "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 3rd edition,2019.

YOUTUBE RESOURCES:

1. Hydraulic Basics by Learn Engineering: This video provides a clear introduction to hydraulic systems, including principles, components, and applications.

2. Pneumatics Basics by RealPars: RealPars offers a series of videos covering the basics of pneumatics, including components, circuits, and operation.

3. Hydraulics and Pneumatics Playlist by SDC Publications: SDC Publications provides a playlist covering various topics in hydraulics and pneumatics, including circuits, symbols, and components.

4. Hydraulic Systems and Components by Aftab Khan: Aftab Khan's channel offers detailed explanations of hydraulic systems, components, and working principles.

Course Code	ENGINEERING METALLURGY	L	T	P	C
ME2402		3	0	0	3

COURSE OBJECTIVES

- To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- To learn selecting and applying various heat treatment processes and its microstructure formation.
- To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- To illustrate the different polymer, ceramics and composites and their uses in engineering field.
- To learn the various testing procedures and failure mechanism in engineering field..

COURSE DESCRIPTION

Engineering Metallurgy is a fundamental course that delves into the study of metallic materials, their properties, processing techniques, and applications in engineering. The course covers topics related to the structure of metals, phase transformations, mechanical properties, corrosion resistance, and heat treatment of metallic alloys. Students learn about different types of metals and alloys, their microstructures, mechanical behavior, material selection criteria, and manufacturing processes.

PREREQUISITES

- Basic knowledge of materials science, chemistry, physics, and engineering principles
- Familiarity with concepts such as atomic structure, chemical bonding, phase transformations, and mechanical behavior of materials

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel - Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V,Ti& W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications overview of materials standards.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – intermetallics- Composites- Matrix and reinforcement Materials applications of Composites - Nano composites

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
- Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
- Clarify the effect of alloying elements on ferrous and non-ferrous metals.
- Summarize the properties and applications of non-metallic materials.
- Explain the testing of mechanical properties.

TEXT BOOKS:

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th edition , 2018.
2. Sydney H. Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994

REFERENCES:

1. A. Alavudeen, N. Venkateshwaran, and J. T.WinowlinJappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. Amandeep Singh Wadhwa, and Harvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
3. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd, New Delhi, 2020.
4. Raghavan. V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 6th edition, 2019.
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, 2nd edition Re print 2019.

YOUTUBE RESOURCES:

1. University Channels: Many universities and educational institutions upload lectures and tutorials related to Engineering Metallurgy. Look for channels from universities known for their materials science or metallurgical engineering programs.

2. Educational Channels: Explore educational channels that specialize in engineering, materials science, or metallurgy. These channels often have playlists or videos dedicated to topics within Engineering Metallurgy.

3. Professional Organizations: Check if professional organizations related to metallurgy or materials science have YouTube channels. They may share conference talks, seminars, or industry insights relevant to Engineering Metallurgy.

4. Online Courses Platforms: Platforms like Coursera, edX, or Khan Academy sometimes offer courses or video lectures on Engineering Metallurgy. You can search for specific courses or topics related to metallurgy on these platforms.

Course Code	TAMILS AND TECHNOLOGY	L	T	P	C
HS2401		1	0	0	1

COURSE DESCRIPTION

Provide an overview of Tamil culture, history, language, literature, arts, traditions, and contributions to civilization, highlighting the rich heritage of the Tamil people. Explore the historical and contemporary contributions of Tamils to technological advancements, innovation, scientific discoveries, engineering, and IT sectors globally.

PREREQUISITES

- Familiarity with Tamil culture, history, language, literature, arts, traditions, and societal values is essential for comprehending the course material and appreciating the role of Tamils in technological advancements.
- A fundamental understanding of technology concepts, digital literacy, computer usage, internet skills, software applications, and familiarity with digital media platforms is beneficial.

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries(BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building – Metallurgical studies – Iron industry – Irons melting, steel – Copper and gold Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads Terracotta beads – Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL (THEORY): 15 HOURS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:
6. Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
7. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
8. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
9. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

YOUTUBE RESOURCES:

1. **Tamil Heritage Foundation:** This channel focuses on Tamil heritage, history, culture, and arts, which may include discussions or lectures related to technology and its impact on Tamil culture.
2. **Tamils in Computing:** This channel aims to highlight the contributions of Tamils in the field of computing and technology, featuring interviews, discussions, and talks with Tamil professionals in tech.
3. **Cognitive Science and Tamil Culture:** While primarily focused on cognitive science and Tamil culture, this channel may cover topics related to technology's influence on language, cognition, and cultural aspects.
4. **Nallu Tamilar:** This channel explores various facets of Tamil culture, history, language, and traditions, occasionally touching upon modern developments and technology trends.

Tamil Language Computing: While focused on Tamil language computing, this channel may offer insights into the technological aspects of Tamil language processing, digital content creation, and software development in Tamil.

Course Code	MECHANICS OF MACHINES	L	T	P	C
ME2403		3	0	2	4

COURSE OBJECTIVES:

- To impart knowledge about forces acting on machine parts.
- To enable students to understand the fundamental concepts of machines
- To facilitate students to understand the functions of cams and gears.
- To make students to get an insight into balancing of rotating and reciprocating masses and the concepts of vibration.

COURSE DESCRIPTION

Mechanics of Machines is an essential course in mechanical engineering that focuses on the study of mechanisms, machine components, and their interactions. The course covers topics such as kinematics, dynamics, mechanisms, machine elements, and their applications in engineering systems. The accompanying laboratory sessions provide hands-on experience in analyzing, designing, and testing mechanical systems and components.

PREREQUISITES

- Basic knowledge of physics, mechanics, and engineering principles
- Familiarity with mathematics (calculus, differential equations, vectors) and computer-aided design (CAD) software is beneficial
- Understanding of materials science, strength of materials, and machine design fundamentals

UNIT I INTRODUCTION 10

General concepts, Introduction of Simple mechanisms, Grublers rule, Grashof's Criterion for mobility-Velocity and accelerations in simple slider crank and four bar mechanisms by relative velocity method, Coriolis component of acceleration. Classification of cam and follower - displacement diagrams - Graphical layouts of cam profiles

UNIT II GEARS 10

Fundamental law of gearing, spur gear contact ratio and interference/undercutting, Epicyclic gear trains – Analysis by tabular method. Basic features of vibratory systems – Single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts

UNIT III BALANCING 10

Static and dynamic balancing of revolving & reciprocating masses in single and multi-cylinder engines- Gyroscopes - Basic concepts - gyroscopic law, effect of gyroscopic couple on ships and aircrafts

TOTAL (THEORY): 30 HOURS

LAB EXERCISES

1. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
2. Determination of Mass Moment of Inertia using bifilar suspension and compound

pendulum

3. Single degree of freedom Spring Mass System – Determination of natural Frequency
4. Multi degree freedom suspension system – Determination of influence coefficient.
5. Balancing of rotating & reciprocating masses.
6. Transverse vibration of Free-Free beam – with and without concentrated masses.
7. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
8. Determination of transmissibility ratio using vibrating table

TOTAL (LAB): 30 HOURS

TOTAL: (30+30) 60 HOURS

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

- Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
- Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
- Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
- Explain the working principles of various turbines and design the various types of turbines.
- Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXTBOOKS:

1. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2020.
2. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms",4th Edition, Oxford University Press, 2014.
4. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014
5. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2020

REFERENCES:

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2020.

3. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2017.

WEB REFERENCES:

- https://lecturenotes.in/notes/2094-notes-for-kinematics-and-dynamics-of-machines

ONLINE RESOURCES:

- http://nptel.iitm.ac.in/courses.php, related web and video resources on Kinematics of Machines and Dynamics of Machines.

YOUTUBE RESOURCES:

1. NPTEL Mechanical Engineering - Dynamics of Machines: This playlist covers topics related to Dynamics of Machines, including kinematics, dynamics, and mechanisms.

2. Mechanical Engineering by Dr. D.K. Dwivedi: Dr. D.K. Dwivedi's channel offers lectures on various topics in Mechanical Engineering, including Mechanics of Machines.

3. Mechanics of Machines by Gate Lectures by Ravindrababu Ravula: This series covers concepts of Mechanics of Machines, including kinematics, dynamics, and mechanisms, with a focus on GATE exam preparation.

4. Mechanisms and Machines by Engineering Academy: Engineering Academy's channel provides tutorials on mechanisms, machine design, and related topics.

5. Mechanics of Machines by Learn Engineering: Learn Engineering offers videos explaining concepts of Mechanics of Machines with animations and visualizations.

Course Code	THERMAL ENGINEERING	L	T	P	C
ME2404		3	0	2	4

COURSE OBJECTIVES:

- To study the fuel properties and performance of I.C Engines.
- To understand the performance of air compressors.
- To impart knowledge of the psychrometric processes and air conditioning systems.

COURSE DESCRIPTION

Thermal Engineering is a core course in mechanical engineering that focuses on the principles and applications of thermodynamics, heat transfer, and thermal systems. The course covers topics such as energy conversion, power cycles, refrigeration, air conditioning, heat exchangers, and thermal system design. The accompanying laboratory sessions provide hands-on experience in conducting experiments, analyzing thermal processes, and testing thermal equipment.

PREREQUISITES

- Basic knowledge of physics, mechanics, and engineering principles
- Familiarity with mathematics (calculus, differential equations) and thermodynamics fundamentals
- Understanding of heat transfer concepts (conduction, convection, radiation) and fluid mechanics is beneficial

UNIT I: IC ENGINE ANALYSIS: Air standard analysis - Carnot cycle - Otto cycle - Diesel cycle, Classification- Principle and working of four stroke and two stroke petrol and diesel engines, Combustion process- Knocking, Detonation, Cetane and Octane numbers, Combustion in SI and CI engines.

UNIT II: AIR COMPRESSORS: Single stage reciprocating compressor- Working principle, Multistage reciprocating compressors: Working principle. Rotary compressor (Descriptive): Vane compressor, Screw compressor and lobe compressor.

UNIT III: PSYCHROMETRY AND AIR CONDITIONING: Psychrometry and Psychrometric charts, Psychrometric process Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, Evaporative cooling, Introduction to HVAC (Descriptive) - Air handling and distribution system, Self cleaning / Electro static precipitation in Air conditioning, Layout of Air conditioner in Automobiles.

TOTAL (THEORY): 30 HOURS

LAB EXERCISES

1. Experimental study on valve timing diagram in 4-stroke engine cut model and port timi diagram in 2-stroke engine cut model.
2. Performance and Heat balance test on a twin cylinder diesel engine with electri dynamometer (Alternator).
3. Performance characteristics of a centrifugal blower test rig.
4. Air compressor test rig (Two stage).

5 Performance and combustion test on computerized Kirloskar TV1 engine with eddy currer dynamometer. (In diesel mode).

6 Experiments on air-conditioning system.

7 Determination of flash and fire point by open cup apparatus.

8 Determination of viscosity using Redwood viscometer.

TOTAL (LAB): 30 HOURS

TOTAL: (30+30) 60 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Identify and describe air standard cycles for air standard efficiencies
- Identify basic components of Engines, differentiate and describe the working (different types of Engines.
- Compare, conduct performance test in Engines and calculate the performance (Engines.
- Compare and calculate the performance of reciprocating and rotary equipment.
- Classify, solve and calculate the psychrometry processes and air conditioning systen performance.
- Conduct test and calculate the properties of fuels and lubricants.

TEXT BOOKS:

1 Kothandaraman C.P, Domkundwar S, "A course in Thermal Engineering", Dhanpat Rai & Co. pvt ltd, 2017.

2 Mahesh M, Rathore, "Thermal Engineering", Mc Draw Hill Education private limited, Reprint 2016.

REFERENCE BOOKS:

1 Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.

2 Ganesan V, Internal Combustion Engine; Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.

3 Arora C.P, "Refrigeration and Air Conditioning", Tata McGraw Hill publishers Co. Ltd, 2017.

WEB REFERENCES:

- http://nptel.ac.in/courses/112104033/
- http://nptel.ac.in/courses/112105128/

ONLINE RESOURCES:

- https://ocw.mit.edu/courses/mechanical-engineering/

YOUTUBE RESOURCES:

1. Thermal Engineering Lectures by Learn Engineering: Learn Engineering offers a series of lectures covering various topics in thermal engineering, including thermodynamics, heat transfer, power cycles, and refrigeration.

2. Thermodynamics and Heat Transfer by NPTEL: NPTEL provides comprehensive lectures on thermodynamics and heat transfer, which are fundamental topics in thermal engineering.

3. Thermal Engineering Basics by Learn Engineering Academy: This series covers the basics of thermal engineering, including thermodynamics laws, heat transfer mechanisms, and applications in engineering.

4. Heat Exchangers and Refrigeration by Chemical Engineering Guy: Chemical Engineering Guy's channel offers videos on heat exchangers, refrigeration systems, and thermal processes in chemical engineering.

5. Thermal Engineering Tutorials by MECH PROFESSOR: MECH PROFESSOR provides tutorials on thermal engineering topics, including power cycles, heat exchangers, HVAC systems, and renewable energy.

Course Code	WELDING TECHNOLOGY	L	T	P	C
ME2405		2	1	3	4

COURSE OBJECTIVES

- To understand the basics of welding and to know about the various types of welding processes
- To elaborate various welding methods including advanced techniques, with emphasis on basic principles, limitations and application.
- To outline metallurgical aspects of welding and its defects

COURSE DESCRIPTION

Welding Technology is a comprehensive course that introduces students to the principles, processes, techniques, and applications of welding in various industries. The course covers topics such as welding methods, welding materials, welding procedures, safety protocols, quality control, and welding inspection. The accompanying laboratory sessions provide hands-on experience in welding operations, equipment handling, weld testing, and troubleshooting.

PREREQUISITES

- Basic knowledge of materials science, metallurgy, and mechanical engineering principles
- Familiarity with manufacturing processes, metal fabrication techniques, and workshop practices
- Understanding of safety regulations, hazard identification, and personal protective equipment (PPE) usage in industrial environments

UNIT I WELDING POWER SOURCES **9**

Classification of welding power sources – basic features of the arc welding power sources- volt-ampere characteristics of a welding power source –volt ampere characteristics – constant current characteristics – constant voltage characteristics - Duty cycle of welding power source. Power sources for MIG/CO_2 welding.

UNIT II WELDING PROCESSES – 1 & WELDING METALLURGY –I **9**

Welding Processes – 1: Classification of welding processes: heat sources, power sources, arc phenomena, arc Dynamics, manual metal arc welding, ingredients and function of flux coating, different types of electrodes and their applications, handling and storage of consumables; Gas tungsten arc welding (GTAW), electrode polarity, shielding gas, GTAW arc process & other recent developments in GTAW & applications Gas metal arc welding, **Welding Metallurgy –I**: Introduction, Regions of a Fusion Weld, Fusion Zone, Unmixed Zone (UMZ), Partially Melted Zone (PMZ), Heat Affected Zone (HAZ),. Iron Carbon equilibrium diagram, Time Temperature diagram, CCT diagrams for carbon steels. Weldability of Stainless steels & Carbon Steels.

UNIT III RESISTANCE AND SOLID-STATE WELDING PROCESSES **9**

General principle- heat generation in resistance welding- Electrical Characteristics of Resistance welding; Spot welding: Principle, variants of resistance spot welding- advantages, disadvantages, and applications of ultrasonic welding.

UNIT IV WELDING PROCESSES –II & WELDING METALLURGY-II **9**

Welding Processes –II : Laser Beam Welding: Basics of Laser, types of Lasers, Principles of operation, effect of parameters on weld quality, advantages, and limitations, applications. Electron beam welding Advanced gas tungsten arc welding: Pulsed GTAW, Square-wave AC GTAW and plasma welding basics- Cold and hot-wire feed additions in GTAW Cold metal Transfer (CMT) - Process characteristics, advantages and applications of above techniques. **Welding Metallurgy-II**: Classification of aluminum alloys Problems involved in aluminium welding – precaution and welding procedure requirements- Classification of copper alloys- influence of alloying elements in copper alloys various processes used for copper welding- problems involved in copper welding – precaution and welding procedure requirements.

UNIT V: WELDING DESIGN 9

Types of weld joints, butt joint, lap joint, T-joint, cruci-form joint, corner joint and edge joint, fillet and groove welds., weld symbols, standard system of representation of welded joints. Design of Welded Joints, welding joint design to control distortion and shrinkage, residual stresses and cracking. Principles and methods and practical approach for crack resistance.

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

Joining Of Metals

1. Simple exercises to make butt, lap, fillet joints using SMAW, GMAW, and GTAW processes.
2. Studying the effect of electrode polarity on weld bead formation
3. Studying the effect of heat input
4. Studying the effect of shielding gases on weld quality
5. Studying the effect of welding parameters of various processes such as SMAW, GMAW, FCAW, GTAW on bead geometry

Weldability Testing & Evaluation

1. Tensile properties evaluation of welded joints
2. Impact toughness properties evaluation of welded joints
3. Microhardness survey across the weld cross section
4. Bend Test (side and face) on welded joints
5. All weld metal properties evaluation
6. Macro and Micro structure analysis of weldments

TOTAL (LAB): 15 HOURS

TOTAL: (45+15) 60 HOURS

COURSE OUTCOMES

Upon completion of this course, the students can able

- Understand the construction and working principles of gas and arc welding process.
- Understand the construction and working principles of resistance welding process.
- Understand the construction and working principles of various solid state welding process.
- Understand the construction and working principles of various special welding processes.
- Understand the concepts on weld joint design, weldability and testing of weldments.

TEXT BOOKS

1. Welding Handbook (Welding Processes), Volume II, 8th Edition, American Welding Society (AWS),1st June 1991.
2. .John C. Lippold, Damian J. Kotecki, Welding metallurgy and weldability of stainless steels, 2005.
3. Resistance welding: Fundamentals and Applications, Hongyan Zhang and Jacek Senkara, Second Edition, CRC Press, 2011
4. .John Norrish. "Advanced welding processes Technologies and process control" Wood head Publishing and Maney Publishing. Cambridge, England. 2006
5. Linnert G.E, Welding Metallurgy, Vol I & II, 4th edition, American Welding Society, 1994.
6. Gray T. G. E. "Rational Welding Design", Butterworth's, 1982

REFERENCE BOOKS

1. Parmer R. S., 'Welding Processes and Technology', Khanna Publishers
2. Little, R.L., Welding and Welding Technology, Tata McGraw Hill, New Delhi, 1996
3. Welding Engineering and Technology, R.S. Parmar, Khanna Publishers, 2013
4. O.P.Khanna, Welding Technology, Dhanpat Rai Publications, New Delhi, 2008
5. Saferian.D, The Metallurgy of Welding, Pergamon Press, 1985
6. Dieter G. "Mechanical Metallurgy", Tata McGraw Hill, 1988

WEB REFERNCES

- http://www.gowelding.com/
- http://www.weldingsoftwarepro.com/
- http://nptel.ac.in/courses/112107077/33

ONLINE RESOURCES

- http://nptel.ac.in/courses/112107078/
- http://kto.simtech.a-star.edu.sg/wsq-graduate-diploma-in-advance-welding-technologies
- http://www.albertatechfutures.ca/RDSupport/Petroleum/BitumenandHeavyOil/EngineeredMaterials /AdvancedWeldingTechnologies.aspx

YOUTUBE RESOURCES:

1. Welding Technology Basics by Weld.com: Weld.com provides a series of videos covering the basics of welding technology, including welding processes, equipment setup, techniques, and safety measures.

2. Welding Techniques and Tips by The Fabrication Series: The Fabrication Series offers tutorials on welding techniques, tips for improving weld quality, troubleshooting common welding problems, and advanced welding skills.

3. Welding Processes Explained by Lincoln Electric: Lincoln Electric's channel provides detailed explanations of various welding processes, such as MIG welding, TIG welding, stick welding, flux-cored welding, and more.

4. Welding Safety and PPE by Miller Welders: Miller Welders offers videos focusing on welding safety practices, personal protective equipment (PPE), hazard awareness, and safe welding techniques

5. Welding Inspection and Quality Control by TWI Ltd: TWI Ltd's channel covers topics related to welding inspection, quality control procedures, non-destructive testing (NDT), weld defects, and quality assurance in welding.

Course Code	DESIGN OF MACHINE ELEMENTS	L	T	P	C
ME2501		3	0	0	3

COURSE OBJECTIVES

- To learn the various steps involved in the Design Process.
- To learn designing shafts and couplings for various applications.
- To learn the design of temporary and permanent Joints.
- To learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for variousapplications.
- To learn designing and select sliding and rolling contact bearings, seals and gaskets. (Use of PSG Design Data book is permitted)

COURSE DESCRIPTION

Design of Machine Elements is a fundamental course in mechanical engineering that focuses on the principles, methods, and techniques involved in designing machine components and systems. The course covers topics such as stress analysis, material selection, design factors, failure theories, and design considerations for various machine elements. Emphasis is placed on understanding the design process, applying engineering principles, and ensuring the functionality, reliability, and safety of machine elements.

PREREQUISITES

1. Basic knowledge of mechanics, strength of materials, materials science, and engineering design fundamentals
2. Familiarity with mathematics (calculus, differential equations) and computer-aided design (CAD) software is beneficial
3. Understanding of manufacturing processes, machine components, and engineering drawing standards

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading-Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys andsplines — Rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentricloads, riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines-- Solidand Rimmed flywheels- connecting rods and crank shafts

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi& Boyd graphs, -- Selection of Rolling Contact bearings –Design of Seals and Gaskets.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Explain the design machine members subjected to static and variable loads.
- Apply the concepts design to shafts, key and couplings.
- Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.
- Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.
- Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

TEXT BOOKS:

1. Bhandari V B, “Design of Machine Elements”, 4th Edition , Tata McGraw-Hill Book Co, 2016
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design”, 10th Edition,Tata McGraw-Hill , 2015.

REFERENCES:

1. Ansel C Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw-Hill Book Co,2004.

2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, “Design of Machine Elements”8th Edition, Printice Hall, 2004.

3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition,Wiley, 2017.

4. Sundararajamoorthy T. V. and Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai,2003.

5. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup,et al. | 25 March 2019

YOUTUBE RESOURCES:

1. Design of Machine Elements by Learn Engineering: This playlist offers a comprehensive overview of machine design principles, including stress analysis, material selection, and design considerations.

2. Machine Design by NPTEL (National Programme on Technology Enhanced Learning): NPTEL provides lectures on various aspects of machine design, covering topics such as design of fasteners, bearings, gears, shafts, and mechanical joints.

3. Machine Design Tutorials by The Engineering Mindset: This series includes tutorials on machine design fundamentals, design calculations, stress analysis, and practical design examples.

4. Design of Machine Elements by Mechanical Engineering Lectures: Mechanical Engineering Lectures covers topics such as design of shafts, keys, couplings, springs, brakes, and clutches in machine elements design.

5. Machine Design and Analysis by MIT OpenCourseWare: MIT OpenCourseWare offers lectures on machine design and analysis, covering design methodologies, design optimization, and case studies.

Course Code	HEAT AND MASS TRANSFER	L	T	P	C
ME2502		3	0	0	3

COURSE OBJECTIVES

- To learn the principal mechanism of heat transfer under steady state and transient conditions.
- To learn the fundamental concept and principles in convective heat transfer.
- To learn the theory of phase change heat transfer and design of heat exchangers.
- To study the fundamental concept and principles in radiation heat transfer.
- To develop the basic concept and diffusion, convective di mass transfer.

COURSE DESCRIPTION

Heat and Mass Transfer is a fundamental course in engineering that explores the principles and mechanisms governing the transfer of heat and mass in various systems. The course covers topics such as conduction, convection, radiation, diffusion, mass transfer, heat exchangers, and applications in engineering and thermodynamics. Emphasis is placed on understanding heat transfer mechanisms, analyzing heat/mass transfer problems, and applying principles to engineering design and analysis.

PREREQUISITES

- Basic knowledge of thermodynamics, fluid mechanics, and engineering mathematics (calculus, differential equations)
- Understanding of energy principles, heat transfer fundamentals, and properties of materials (thermal conductivity, heat capacity, density) is recommended
- Familiarity with engineering software tools for mathematical modeling, computational analysis, and data visualization

UNIT I CONDUCTION **9**

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction –– plane and Composite Systems – Conduction with Internal Heat Generation –Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts – Methods of enhanced thermal conduction

UNIT II CONVECTION **9**

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **9**

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation- Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods - Fundamentals of Heat Pipes and its applications

UNIT IV RADIATION **9**

Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy- Radiation Shields

UNIT V MASS TRANSFER **9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion -Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- Apply heat conduction equations to different surface configurations under steady state andtransient conditions and solve problems.
- Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
- Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermalanalysis to different types of heat exchanger configurations and solve problems.
- Explain basic laws for Radiation and apply these principles to radiative heat transfer betweendifferent types of surfaces to solve problems.
- Apply diffusive and convective mass transfer equations and correlations to solve problems fordifferent applications.

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age InternationalPublishers, 2009
2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5th Edition – 2013

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley &Sons, 7th Edition, 2014.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, NewDelhi, 2012
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

YOUTUBE RESOURCES:

1. Heat and Mass Transfer Lectures by LearnChemE (University of Colorado Boulder): LearnChemE offers a comprehensive series of lectures covering fundamental concepts in heat and mass transfer, including conduction, convection, radiation, and diffusion.

2. Heat Transfer Basics by Khan Academy: Khan Academy provides introductory videos on heat transfer basics, including thermal conductivity, heat conduction, convection, and heat exchangers.

3. Heat and Mass Transfer by NPTEL (National Programme on Technology Enhanced Learning): NPTEL offers lectures on various topics in heat and mass transfer, such as heat conduction, convection, radiation, mass diffusion, and heat exchangers.

4. Engineering Heat Transfer by The Organic Chemistry Tutor: The Organic Chemistry Tutor provides tutorials on engineering heat transfer topics, including Fourier's law, Newton's law of cooling, heat exchangers, and thermal conductivity.

5. Heat Transfer Lectures by Dr. Chandra Shekhar: Dr. Chandra Shekhar's channel offers lectures on heat transfer principles, applications in engineering, heat exchangers, and heat transfer coefficients.

Course Code	PRODUCT LIFE CYCLE MANAGEMANT	L	T	P	C
ME2503		3	0	2	4

COURSE OBJECTIVES

1 To study about the history, concepts and terminology in PLM

2 To learn the functions and features of PLM/PDM

3 To develop different modules offered in commercial PLM/PDM tools

4 To demonstrate PLM/PDM approaches for industrial applications

5 To use PLM/PDM with legacy data bases, Coax& ERP systems

COURSE DESCRIPTION

Exploring emerging technologies and trends shaping the future of PLM, such as digital twins, IoT integration, and AI-driven analytics- The impact of globalization, sustainability initiatives, and changing consumer preferences on PLM strategies- Design considerations throughout the product life cycle, including design for manufacturability, sustainability, and cost-effectiveness. Engineering processes and methodologies to optimize product performance and quality

PREREQUISITES

- Understanding of project management principles, including project planning, scheduling, budgeting, and risk management.
- Familiarity with project management tools and techniques such as Gantt charts, critical path analysis, and resource allocation.

UNIT – I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT – II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management - Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software-selection criterion of software for particular application - Brand name to be removed

UNIT – IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance- process compliance and process automation

UNIT – V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

- Summarize the history, concepts and terminology of PLM
- Develop the functions and features of PLM/PDM
- Discuss different modules offered in commercial PLM/PDM tools.
- Interpret the implement PLM/PDM approaches for industrial applications.
- Integrate PLM/PDM with legacy data bases, Coax& ERP systems

YOUTUBE RESOURCES:

1. **Siemens PLM Software:** Siemens PLM Software offers various videos and tutorials on PLM solutions, including product lifecycle management, digital twins, simulation, and more
2. **Product Lifecycle Management (PLM**): PTC's PLM channel covers topics related to digital transformation, IoT, CAD/CAM, and product lifecycle management strategies Dassault Systems - PLM:
3. **Dassault Systems -** PLM: Dassault Systems' PLM videos showcase their solutions for digital manufacturing, 3D design, simulation, and collaboration across the product lifecycle
4. **Tech-Clarity:** Tech-Clarity's channel features videos on PLM best practices, industry trends, digital transformation, and technology adoption in manufacturing
5. **The PLM Doctor**: The PLM Doctor provides insights into product lifecycle management strategies, implementation tips, and interviews with industry experts

PLM LABORATORY

COURSE DESCRIPTION

The PLM Laboratory is designed to provide hands-on experience and practical skills in using Product Lifecycle Management software tools commonly used in industry. The course focuses on understanding the PLM process, managing product data, collaborating on design projects, and optimizing workflows for efficient product development. Students will learn how to use PLM software for CAD data management, BOM (Bill of Materials) management, change management, collaboration, and version control.

PREREQUISITES

- Basic knowledge of CAD software tools such as SolidWorks, AutoCAD, CATIA, or similar
- Understanding of engineering design principles, product development processes, and manufacturing concepts
- Familiarity with data management concepts, file organization, and document control

practices in engineering environments

Introduction, Installation & maintenance of following software: DBMS, Java, PLM Server, CAD Software, MS Office, Application server, Software/ Hardware/ Network issues resolutions.

CAD: Modeling (at least 5 parts) and Assembly using any High End CAD Software. Assembly should include top down and bottom-up approaches, Drafting (at least 1 assembly).

CAD File/data exchange amongst the various CAD software and software for CMM, CAE, CNC, CAM **FEA**: Analysis (structural, thermal and both) of at least two parts, Introduction to nonlinear analysis **PLM:** Exhibiting use of following modules of any PLM software through at least six assignments

- Organization
- Workflow
- Product Structure
- Access Manager
- Query Builder
- Change Management
- Schedule Manager
- Manufacturing Process Planner

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10: 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989)ISBN-10: 0899303196

REFERENCES:

1. Antti Saaksvuori and Ansel miImmonen, "Product Lifecycle Management", Springer Publisher, 2008 (3rd Edition)
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003
3. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007
4. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

TOTAL (LAB): 30 HOURS

TOTAL: (45+30) 75 HOURS

YOUTUBE RESOURCES:

1. **University Lectures and Demonstrations:** Look for university lectures or demonstrations on PLM systems. Some universities may have recorded lectures or lab sessions related to PLM, which they share on their YouTube channels or learning platforms.

2. **Industry Webinars and Workshops:** Many PLM software vendors and industry organizations host webinars, workshops, and conferences where they discuss PLM best practices, case studies,

and software demonstrations. Look for recordings of such events on YouTube or the respective websites.

3. **PLM Software Community Forums:** Explore PLM software community forums and discussion boards. Sometimes, users share their own tutorials, tips, and tricks on YouTube or other platforms.

4. **Online Learning Platforms:** Platforms like LinkedIn Learning, Coursera, Udemy, and Pluralsight may offer courses or tutorials on PLM concepts and software. While they may require a subscription or purchase, they can be valuable resources.

Course Code	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
ME2601		3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues (Use of P S G Design Data Book permitted)

COURSE DESCRIPTION

The course covers topics such as power transmission, gear design, belt and chain drives, coupling design, and shaft design, emphasizing the selection of appropriate components based on application requirements. Students learn to analyze torque, speed, load, and other factors to design reliable, efficient, and durable transmission systems for different types of machinery and equipment.

PREREQUISITES

- Basic understanding of mechanics, materials science, and engineering design principles
- Familiarity with mathematics (calculus, trigonometry, and algebra) for calculations related to torque, speed, load, and gear ratios
- Knowledge of CAD software tools for 3D modeling, assembly design, and simulations (though this may be taught as part of the course)

UNIT I DESIGN OF FLEXIBLE ELEMENTS **9**

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS **9**

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS **9**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXES **9**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES **9**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL: 45 HOURS

OUTCOMES:

Upon the completion of this course the students will be able to

- Apply the concepts of design to belts, chains and rope drives.
- Apply the concepts of design to spur, helical gears.
- Apply the concepts of design to worm and bevel gears.
- Apply the concepts of design to gear boxes
- Apply the concepts of design to cams, brakes and clutches.

TEXT BOOKS:

1. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000. th
4. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4 Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.

YOUTUBE RESOURCES:

1. Design of Transmission Systems - Gear Design by Learn Engineering: This video explains gear design principles, types of gears, gear terminology, and considerations for designing gears in transmission systems.

2. Transmission System Design by MIT Open Course Ware: MIT Open Course Ware offers lectures on transmission system design covering topics such as gear trains, belt drives, chain drives, and bearing selection.

3. Belt Drives and Chain Drives by The Engineering Mindset: This video discusses belt drives and chain drives, their advantages, limitations, design considerations, and calculations for designing transmission systems.

4. Design of Shaft by NPTEL Mechanical Engineering: NPTEL provides a lecture on the design of shafts, including shaft materials, sizing, keyways, stress analysis, and considerations for shaft design in transmission systems.

5. Coupling Design Basics by Khan Academy: Khan Academy's video covers the basics of coupling design, types of couplings, factors affecting coupling selection, and considerations for coupling design in transmission systems.

Course Code	FINITE ELEMENT ANALYSIS	L	T	P	C
ME2602		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

COURSE DESCRIPTION

Provide an overview of FEA as a numerical simulation technique used in engineering to analyze complex structures, components, and systems under various loading conditions. Cover fundamental concepts such as discretization, element types (e.g., beam, truss, shell, solid), mesh generation, boundary conditions, material properties, and loading conditions. Introduce students to industry-standard FEA software tools such as ANSYS, Abaqus, SolidWorks Simulation, or similar, and provide hands-on training in using these tools for analysis and simulation tasks.

PREREQUISITES

- A solid understanding of engineering mechanics is essential, including topics such as statics, dynamics, mechanics of materials, and structural analysis. Knowledge of forces, moments, equilibrium, stress, and strain is fundamental for FEA.
- Proficiency in mathematics is crucial, particularly in calculus (including differential equations), linear algebra, numerical methods, and vector calculus. These mathematical concepts are extensively used in FEA formulations and analyses.

UNIT I BASICS OF FEA AND ONE-DIMENSIONAL PROBLEMS 10

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method. One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

UNIT II TWO DIMENSIONAL SCALAR AND VECTOR VARIABLE PROBLEMS 10

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors - Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements - Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements

UNIT III ISOPARAMETRIC FORMULATION 10

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL: 30 HOURS

LAB EXERCISES

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL (LAB): 30 HOURS
TOTAL: (30+30) 60 HOURS

COURSE OUTCOMES

- Summarize the basics of finite element formulation.
- Apply finite element formulations to solve one dimensional Problem
- Apply finite element formulations to solve two dimensional scalar Problems. Apply finite element method to solve two dimensional Vector problems.
- Apply finite element method to solve problems on iso parametric element and dynamic Problems.
- Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB.
- Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.
- Calculate the natural frequency and mode shape analysis of 2D components and beams.

TEXT BOOKS:

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)*
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

YOUTUBE RESOURCES:

1. Solid Professor: Solid Professor offers tutorials and training videos on various engineering software tools, including FEA software such as SolidWorks Simulation, ANSYS, and more.

2. ANSYS How To Videos: ANSYS' official YouTube channel provides tutorials, webinars, and demonstrations for ANSYS software, covering topics related to FEA, structural analysis, thermal analysis, and more.

3. Abaqus Tutorial: Abaqus Tutorial offers tutorials, tips, and guides for using Abaqus FEA software, covering various analysis types, modeling techniques, and simulation procedures.

4. Sim Scale: Sim Scale's channel provides tutorials and simulations using cloud-based FEA software, covering structural mechanics, fluid dynamics, thermal analysis, and multi physics simulations.

5. FEA Solutions: FEA Solutions offers tutorials, case studies, and educational content on FEA software tools, finite element modeling techniques, and simulation methodologies.

Course Code	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
ME2603		2	0	2	3

OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

COURSE DESCRIPTION

Provide an introduction to Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM), highlighting their roles in modern engineering and manufacturing processes. Introduce students to industry-standard CAD software tools such as AutoCAD, SolidWorks, CATIA, or similar, and cover fundamental concepts of 2D drafting, 3D modeling, assemblies, and parametric design. Explore CAM software tools used for CNC machining, toolpath generation, manufacturing simulations, and post-processing operations. Discuss integration with CAD models and CAM workflows.

PREREQUISITES

- Proficiency in using computers, operating systems (e.g., Windows, macOS), and basic software applications (e.g., Microsoft Office suite) is necessary for working with CAD/CAM software tools and lab equipment.
- Familiarity with technical drawing conventions, engineering graphics, orthographic projections, isometric views, and dimensioning practices is important for interpreting and creating engineering drawings.

UNIT I INTRODUCTION TO GEOMETRIC MODELING AND CAD STANDARDS 10

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – CAD/CAM concepts ––Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep. Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standard.

UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMING 10

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

UNIT V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) 10

Group Technology(GT),Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS

TOTAL: 30 HOURS

LAB EXERCISES

1. Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing
2. Bearings - Bush bearing, Plummer block
3. Valves – Safety and non-return valve
4. Couplings – Flange, Universal, Oldham's, Muff, Gear couplings
5. Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
6. Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
7. Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

TOTAL HOURS (LAB): 30
TOTAL HOURS: (30+30) 60

COURSE OUTCOMES

- Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics
- Explain the fundamentals of parametric curves, surfaces and Solids
- Summarize the different types of Standard systems used in CAD
- Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines
- Summarize the different types of techniques used in Cellular Manufacturing and FMS
- Follow the drawing standards, Fits and Tolerances
- Re-create part drawings, sectional views and assembly drawings as per standards

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007
2. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
3. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.
4. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013.

REFERENCES:

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.

2. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc,1992.

3. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education -2003

4. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

5. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers,2013

6. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004

7. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing" , published by Tata Mc GrawHill,2006

YOUTUBE RESOURCES:

1. SolidWorks: SolidWorks' official YouTube channel offers tutorials, tips, and demonstrations for using SolidWorks CAD software, covering topics such as 3D modelling, assemblies, simulations, and CAM integration.

2.Autodesk Fusion 360: Autodesk Fusion 360's channel provides tutorials, webinars, and design projects using Fusion 360 CAD/CAM software, including 3D modelling, generative design, machining strategies, and collaborative workflows.

3. CATIA: CATIA's official channel offers tutorials and showcases for CATIA software, covering CAD modeling, surface design, assembly design, kinematics, and advanced design features.

4. Siemens NX: Siemens NX's YouTube channel provides tutorials, tips, and training sessions for NX CAD/CAM/CAE software, including 3D modelling, simulation, tool path generation, and manufacturing processes.

5. Mastercam: Mastercam's channel offers tutorials, webinars, and machining demonstrations for Mastercam CAD/CAM software, covering topics such as toolpath creation, CNC programming, and machining operations.

Course Code	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
ME2701		2	0	0	2

OBJECTIVE:

- To introduce the process planning concepts to make cost estimation for various products after process planning

COURSE DESCRIPTION

- Covers the process of selecting appropriate manufacturing processes based on product requirements, materials, tolerances, and production volumes.
- Discuss design for manufacturability (DFM) principles and considerations.
- Explores methods for analyzing and optimizing process flows, including process mapping, value stream mapping (VSM), time studies, and efficiency improvements. Discusses strategies for material selection, procurement, inventory management, and resource allocation to ensure smooth production operations and minimize waste.

PREREQUISITES

- Familiarity with technical drawing, blueprint reading, and computer-aided design (CAD) software is beneficial for understanding engineering drawings, layouts, and process flow diagrams commonly used in process planning.
- Knowledge of various manufacturing processes, such as machining, casting, forming, welding, and assembly, is important for understanding process capabilities, limitations, and cost implications.

UNIT I INTRODUCTION TO PROCESS PLANNING 6

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT IIPROCESS PLANNING ACTIVITIES 6

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 6

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labour cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 6

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 6

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL: 30 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

- Select the process, equipment and tools for various industrial products.
- Prepare process planning activity chart.
- Explain the concept of cost estimation.
- Compute the job order cost for different type of shop floor.
- Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCES:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.

YOUTUBE RESOURCES:

1. MIT Open Course Ware: MIT Open Course Ware offers lectures and course materials from MIT's Mechanical Engineering department, including topics on manufacturing processes, process planning, and related engineering concepts.

2. Learn Engineering - Manufacturing: Learn Engineering provides educational videos on various engineering topics, including manufacturing processes, automation, and quality control, which are relevant to process planning and cost estimation.

3. Engineering explained - Manufacturing: Engineering Explained covers engineering concepts, technologies, and processes, including topics related to manufacturing, production planning, and cost analysis.

4. The Engineering Mindset: Manufacturing Engineering: The Engineering Mindset channel offers videos on engineering fundamentals, industrial processes, and automation, with content that touches on process planning and cost estimation aspects.

5. GATE Lectures by Ravindrababu Ravula: Industrial Engineering: This channel provides lectures and tutorials on topics relevant to industrial engineering, including process planning, production management, and cost estimation techniques.

Course Code	AUTOMOBILE ENGINEERING	L	T	P	C
ME2702		2	0	0	2

COURSE OBJECTIVES

- To study the construction and working principle of various parts of an automobile.
- To study the practice for assembling and dismantling of engine parts and transmission system
- To study various transmission systems of automobile.
- To study about steering, brakes and suspension systems
- To study alternative energy sources

COURSE DESCRIPTION

Explore the various types of powertrains used in automobiles, including internal combustion engines (gasoline, diesel), electric powertrains (battery-electric, hybrid, plug-in hybrid), and alternative fuel systems (e.g., hydrogen fuel cells). Discuss the principles of automotive design, including aerodynamics, ergonomics, safety considerations, and materials selection. Cover manufacturing processes such as casting, machining, welding, and assembly.

PREREQUISITES

- A strong foundation in mathematics, including calculus, algebra, geometry, and differential equations, is essential for understanding and analyzing engineering principles and calculations in automotive engineering.
- Proficiency in CAD software tools (e.g., AutoCAD, SolidWorks, CATIA) for 2D and 3D modeling is valuable for designing and analyzing automotive components and assemblies.

UNIT – I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT – II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT – III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT – IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control

UNIT – V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 HOURS

OUTCOMES: At the end of the course the students would be able to

1. Recognize the various parts of the automobile and their functions and materials.
2. Discuss the engine auxiliary systems and engine emission control.
3. Distinguish the working of different types of transmission systems.
4. Explain the Steering, Brakes and Suspension Systems.
5. Predict possible alternate sources of energy for IC Engines.

TEXT BOOKS:

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002
2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014

REFERENCES:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart – Will Cox Company Inc, USA ,1978.
5. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 1989.

YOUTUBE RESOURCES:

1. Engineering Explained: This channel covers a wide range of engineering topics, including automotive engineering, vehicle dynamics, engines, drivetrains, and automotive technology explanations.

2. Learn Engineering: Learn Engineering provides educational videos on engineering concepts, mechanisms, and technologies, including automotive engineering principles and components.

3. SAE International: SAE International's channel features technical content, webinars, and industry insights related to automotive engineering, vehicle technology, mobility solutions, and standards development.

4. Engineering Explained - Motorsports: This spin-off channel from Engineering Explained focuses specifically on motorsports engineering, covering topics such as race car design, aerodynamics, suspensions, and performance tuning.

5. Real Engineering: Real Engineering explores engineering concepts across various disciplines, including automotive engineering-related topics such as vehicle design, engineering innovations, and future mobility solutions.

Course Code	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
ME2703		3	0	0	3

COURSE OBJECTIVES

- To understand Smart Objects and loT Architectures
- To learn about various IOT-related protocols
- To build simple loT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of loT
- To develop loT infrastructure for popular applications.

COURSE DESCRIPTION

- Cover the foundational technologies that underpin IIoT, such as sensors, actuators, communication protocols (e.g., MQTT, CoAP), edge computing, cloud computing, and data analytics.
- Discuss the different types of connectivity options (e.g., wired, wireless, cellular) and networking architectures (e.g., star, mesh, edge-to-cloud) commonly employed in IIoT environments.

PREREQUISITES

- Familiarity with industrial automation principles, control systems (e.g., PLCs, SCADA), and manufacturing processes provides a foundational understanding of the industrial environment where IIoT technologies are deployed.
- Experience or knowledge in systems integration methodologies, protocols (e.g., RESTful APIs, MQTT), and interoperability standards is valuable for integrating IIoT devices and systems with existing industrial infrastructures.

UNIT I FUNDAMENTALS OF loT 9

Evolution of Internet of Things - Enabling Technologies - loT Architectures: oneM2M, loT World Forum (loT WF) and Alternative loT models - Simplified loT Architecture and Core loT Functional Stack - Fog, Edge and Cloud in loT - Functional blocks of an loT ecosystem - Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II: loT PROTOCOLS

loT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11 ah and LoRa WAN - Network Layer: IP versions, Constrained Nodes and Constrained Networks - Optimizing IP for loT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMEN 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - loT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for loT, Python Web Application Framework - Django -AWS for loT - System Management with NETGONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco loT system - IBM Watson loT platform - Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry - GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

CO 1. Explain the concept of loT

CO 2. Analyze various protocols for loT

CO 3. Design a Poe of an +o'T system using Rasperry Pi/Arduino

CO 4. Apply data analytics and use cloud offerings related to loT

TEXT BOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete. Rob Barton and Jerome Henry, "loT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach||, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi, —The Internet of Things – Key applications and Protocols||, Wiley, 2012

REFERENCES:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Aves and. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
3. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance your projects, 2nd Edition, O'Reilly_Media,_2011

YOUTUBE RESOURCES:

1. IBM Internet of Things: IBM's official IoT channel covers various topics related to IoT and IIoT, including industry-specific applications, case studies, and technology demonstrations.

2. Siemens' YouTube channel includes videos on industrial automation, digitalization, and IoT solutions, offering insights into how IIoT is transforming manufacturing and other industries.

3. Cisco's IoT channel features videos on IoT architectures, cybersecurity, edge computing, and smart city solutions, providing a comprehensive view of IoT technologies and trends.

4. Microsoft Azure's IoT playlist covers tutorials, webinars, and case studies related to IoT development, data analytics, and cloud integration using Azure IoT services.

5. Bosch's YouTube channel features videos on IoT innovations, smart manufacturing, connected devices, and IoT solutions for automotive, industrial, and smart city applications.

APPENDIX B: OPEN ELECTIVES I

S.N	COURSE CODE	COURSE TITLE
1.	ME2601	Lean Concepts, Tools and Practices
2.	ME2602	Reverse Engineering
3.	ME2603	Fire Safety Engineering
4.	ME2604	Fundamentals of Aeronautical Engineering
5.	ME2605	Nano Technology
6.	ME2606	Functional Materials
7.	ME2607	Solar Energy Conversion Systems
8.	ME2608	Basics of Plastics Processing
9.	ME2609	Machine Learning for Smart Manufacturing

OPEN ELECTIVES – II

SL. NO.	COURSE CODE	COURSE TITLE
1.	ME2701	Technical Writing
2.	ME2702	Production and Operations Management for Entrepreneurs
3.	ME2703	Nanomaterials and Applications
4.	ME2704	Concepts in Mobile Robotics
5.	ME2705	Renewable Energy
6.	ME2706	Energy Technology
7.	ME2707	Plastic Materials for Engineers
8.	ME2708	Properties and Testing of Plastics
9.	ME2709	Professional Ethics in Engineering

Course Code	LEAN CONCEPTS, TOOLS AND PRACTICES	L	T	P	C
ME26O1		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I Introduction **9**

Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with respect to its management practices -construction project phases - The problems with current construction management techniques.

UNIT IILean Management **9**

Introduction to lean management - Toyota's management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.

UNIT III Core Concepts in Lean **9**

Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.

UNIT IV Lean Tools and Techniques **9**

Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting-Daily Huddles – Root cause analysis – Continuous improvement – Just in time.

UNIT VLean Implementation in Construction Industry **9**

Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

TOTAL: 45 HOURS

COURSE OUTCOMES:

CO1: Explains the contemporary management techniques and the issues in present scenario.

CO2: Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.

CO3: Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.

CO4: Apply lean techniques to achieve sustainability in construction projects.

CO5: Apply lean construction techniques in design and modeling.

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013..
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., andTzortzopoulos, P.,Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

Course Code	REVERSE ENGINEERING	L	T	P	C
ME26O2		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Analysing the various legal aspect and applications of reverse engineering in product design and development.
- Understand about 3D scanning hardware & software operations and procedure to generate 3D model

UNIT I INTRODUCTION & GEOMETRIC FORM 9

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT III DATA PROCESSING 9

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT IV 3D SCANNING AND MODELLING 9

Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT VINDUSTRIAL APPLICATIONS 9

Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry - Case studies and Solving Industrial projects in Reverse Engineering - Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.

45 HOURS

COURSE OUTCOMES:

- Apply the fundamental concepts and principles of reverse engineering in product design and development.
- Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

REFERENCES:

1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, "Reverse Engineering", McGraw-Hill, 1994.
4. Linda Wills, "Reverse Engineering", Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, "Reverse Engineering: An Industrial Perspective", Springer Verlag London Limited 2008.

Course Code	FIRE SAFETY ENGINEERING	L	T	P	C
ME26O3		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non combustibility & fire resistance
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I INHERENT SAFETY CONCEPTS **9**

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.

UNIT II PLANT LOCATIONS **9**

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements standard heating condition, Indian standard test method, performance criteria.

UNIT III WORKING CONDITIONS **9**

Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES **9**

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS **9**

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

TOTAL :45 HOURS

COURSE OUTCOMES: Upon completion of the course, the student will be able to

CO1: Understand the effect of fire on materials used for construction

CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.

CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.

CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS:

1. Roytman, M. Y, ”Principles of fire safety standards for building construction”. Amerind Publishing Co. Pvt. Ltd., New Delhi,1975
2. John A. Purkiss, ”Fire safety engineering design of structures” (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.

REFERENCES:

1. Smith, E.E. and Harmathy, T.Z. (Editors),”Design of buildings for fire safety”. ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, ”Designing of fire safety”. John Wiley and Sons Ltd., New York, U.S.A.1983.
3. Jain, V.K,”Fire safety in buildings” (2nd edn.). New Age International(P) Ltd., New Delhi,2010.
4. Hazop & Hazan, ”Identifying and Assessing Process Industry Hazards”, Fourth Edition ,1999
5. Frank R. Spellman, Nancy E. Whiting,” The Handbook of Safety Engineering: Principles and Applications”, 2009

Course Code	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	L	T	P	C
ME26O4		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT 9

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 9

Different types of flight vehicles, classifications-Components of an airplane and their functions Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9

Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems

UNIT V BASICS OF PROPULSION 9

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL: 45 HOURS

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

- Illustrate the history of aircraft & developments over the year
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.

- Distinguish the types of Engines and explain the principles of Rocket.

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw Hill; 8th edition , 2015
2. E Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021
3. Stephen. A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCES

1. Sadhu Singh, “Internal Combustion Engines and Gas Turbine”-, SS Kataraia & Sons, 2015
2. Kermode , “Flight without Formulae”, -, Pitman; 4th revised edition 1989

<table>
<tr><td>Course Code</td><td rowspan="2">NANO TECHNOLOGY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>ME2605</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
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COURSE OBJECTIVES:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I INTRODUCTION **9**

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact

UNIT II SYNTHESIS OF NANOMATERIALS **9**

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES **9**

Definition- importance of nanocomposites- nano composite materials-classification of composites metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES **9**

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS **9**

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications

CO2: Able to acquire knowledge about the different types of nano material synthesis

CO3: Describes about the shape, size,structure of composite nano materials and their interference.

CO4: Understand the different characterization techniques for nanomaterials

CO5: Develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS:

1. Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES:

1. R.H.J. Hannink & A.J. Hill, Nanostructure Control, Wood Head Publishing Ltd., Cambridge, 2006.
2. C.N.R. Rao, A.Muller, A.K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J.Muray,'The physics of Micro/Nano – Fabrication', Springer International Edition,2010

Course Code	FUNCTIONAL MATERIALS	L	T	P	C
ME2606		3	0	0	3

COURSE OBJECTIVES:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I INTRODUCTION 9

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact

UNIT II MOLECULAR SELF ASSEMBLY 9

Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed AssemblyLangmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.

UNIT III BIO-INSPIRED MATERIALS 9

Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics'-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology.

UNIT IV SMART OR INTELLIGENT MATERIALS 9

Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electro ceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites

UNIT V MATERIALS FOR POLYMER ELECTRONICS 9

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOKS:

1. Vijayamohanan K. Pillai and Meera Parthasarathy, "Functional Materials: A chemist's perpective", Universities Press Hyderabad (2012).

REFERENCES:

1. Stephen Manne "Biomimetic Materials Chemistry" Wiley-VCH New York, 1966

Course Code	BASICS OF PLASTICS PROCESSING	L	T	P	C
ME26O7		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding,
- Compression and Transfer molding, Blow molding, Thermoforming and casting)
- To understand suitable additives for plastics compounding
- To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I INTRODUCTION TO PLASTICS PROCESSING **9**

Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing - Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization

UNIT II EXTRUSION **9**

Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooing - Factors determining efficiency of an extruder - Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications - Applications of extrusion and new developments

UNIT III INJECTION MOLDING **9**

Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle - Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area - Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding - Thermoplastic vs. thermosetting injection moulding - Injection moulding vs. other plastic processing techniques - State-of-the art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING **9**

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating Techniques of preheating - Machines used-Types of compression mould- positive, semi-positive and flash - Common moulding faults and their correction - Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V BLOW MOLDING, THERMOFORMING AND CASTING 9

Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

CO1: Ability to find out the correlation between various processing techniques with product properties.

CO2: Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.

CO3: Acquire knowledge on additives for plastic compounding and methods employed for CO3the same

CO4: Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.

CO5: Select an appropriate processing technique for the production of a plastic product

REFERENCES:

1. S. S. Schwart, S. H. Goodman, Plastics Materials and Processes, Van Nostrad Reinhold Company Inc. (1982).
2. F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).
3. W. S. Allen and P. N. Baker, Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).
4. M. Chanda, S. K. Roy, Plastic Technology handbook, 4th Edn., CRC Press (2007).
5. I. Rubin, Injection Molding Theory & Practice, Society of Plastic Engineers, Wiley (1973).
6. D.V. Rosato, M. G. Rosato, Injection Molding Hand Book, Springer (2012).
7. M. L. Berins (Ed.), SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc., Springer (2012).
8. B. Strong, Plastics: Material & Processing, A, Pearson Prentice hall (2005).
9. D.V Rosato, Blow Molding Hand Book, Carl Hanser Verlag GmbH & Co (2003).

Course Code	SOLAR ENERGY CONVERSION SYSTEMS	L	T	P	C
ME2608		3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of Solar Energy Conversion Systems (SECS).
- To explore the engineering principles, economic analysis, and meteorological data that influence the design and optimization of SECS

UNIT I INTRODUCTION TO SOLAR ENERGY CONVERSION SYSTEMS 9

Solar Radiation- Astronomical Parameters- Interaction of Solar Radiation with the Atmosphere

UNIT II SOLAR ENERGY RADIATIVE FLUX DEPLETION 9

Optical Depth for a Vertical Path- Atmospheric Mass- Integral Transmission Factor of the Atmosphere- Attenuation of Solar Radiation by Clouds

UNIT III CORRELATION WITH METEOROLOGICAL CONDITIONS 9

Depletion "Constant" of the Atmosphere- Quantitative Aspects of Cloud Presence- Solmet - Meteorological Data- Model Input Data.

UNIT IV APPENDICES AND ADDITIONAL RESOURCES 9

Definitions and Units of Measure for Irradiance- Radiation Laws Applied to Computation of Solar Energy Fluxes- Computation of Precipitable Water and Equivalent Height of the Atmosphere- Insolation Climatology Data on SOLMET Format- W.M.O. Cloud Definition and Classification- Analogic Records of Surface Weather Observation.

UNIT V ADVANCED TOPICS IN SOLAR ENERGY 9

Solar Cell Technologies- Concentrated Solar Power Systems- Solar Thermal Collectors- Photovoltaic System Design- Energy Storage for Solar Applications.

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

REFERENCES:

1. G. Russo, "Analytical Models and Numerical Simulation Codes for Solar Energy Systems' Engineers (I)," Fourth Course on Solar Energy Conversion, International Center for Theoretical Physics, Italy, 1977.
2. G. Russo, "Passive and Active Systems Radiation Dynamics," Act of the Congress SAIE 77, Italy, 1977.
3. Russo and G. Russo, "Analytical Models and Numerical Simulation Codes for Solar Energy Systems Engineering (II)," Fourth Course on Solar Energy Conversion, International Center for Theoretical Physics, Italy, 1977.

4. G. Russo, "Design of Solar Energy Conditioning Systems," Technical Report, Polytechnic of Torino, School of Engineering, Torino, Italy, 1975.
5. G. Russo, "Solar Collectors: Testing Loop Design," FIAT C.R.F. Technical Report No. 528/75/lmr, 1975

Course Code	MACHINE LEARNING FOR SMART MANUFACTURING	L	T	P	C
ME26O9		3	0	0	3

COURSE OBJECTIVES:

Impart knowledge of smart manufacturing for industry 4.0 for making student innovative

UNIT I INDUSTRY 4.0 **9**

Concept, Globalization and emerging issues, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories

UNIT II AUTOMATION **9**

Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC, Sensor, Smart Sensor, HMI design, Cyber Physical System – key components, ISA-95 architecture, CPS-5C architecture, Concept of Digit Twin.

UNIT III COMMUNICATION **9**

Protocols – MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server, Programming with – Free and open-source software, Propriety software; Augmented Reality.

UNIT IV IOT PLATFORM **9**

Data Modelling, IoT platforms – Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine interfaces – Cloud-based Mosquitto brokers, Programming with – Free and open-source software, Propriety software.

UNIT V MACHINE LEARNING FOUNDATION **9**

Learning algorithms – Supervised, Unsupervised, Self learning, Feature learning, etc. Models – Artificial Neural Networks, Decision trees, Regression analysis, Genetic algorithms, etc.; Programming with – Free and open-source software, Propriety software

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

- Introduce concept of Industry 4.0 for Smart Manufacturing.
- Understand various hardware used in Smart Manufacturing.
- Understand need of various communication protocols. hardware and software, IoT Layers and their relative importance.
- Understand could-computing IoT platform for Smart Manufacturing.
- Understand machine learning to make smart factories.
- Understand application of hardware, communication protocol, IOT platform, machine learning etc. to implement IoT for smart manufacturing for the need of Industry 4.0.

REFERENCES:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics", Spinger Gabler, 2015 2.
2. Alasdair Gilchrist, "Industry 4.0 – The Industrial Internet of Thigs", Springer Link, 2016 3.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications. 4.
4. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer. 5.
5. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications. 6.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications 7.
7. W. Botton, "Programmable Logic Controllers", Fourth Edition, Elsevier, 2006
8. P. Juahs, K. Molnar, "Key Components of the Architecture of Cyber-physical manufacturing systems", International Scientific Journal "Industry 4.0", 2017, issue 5, 205- 207
9. Jen-Ruey Jiang, "An improved cyber-physical systems architecture for Industry 4.0 smart factories", Advances in Mechanical Engineering, 2018, Vol. 10(6) 1-15

OPEN ELECTIVES – II

Course Code	TECHNICAL WRITING	L	T	P	C
ME2701		3	0	0	3

COURSE OBJECTIVES:

- To understand the present complex information in a clear and easily understandable way to the target audience, which involves breaking down intricate concepts into simpler terms and providing clear explanations

UNIT I INTRODUCTION TO TECHNICAL WRITING **9**

Characteristics of Technical Writing - Rhetorical awareness - Ethics - Steps in the technical writing process- Prewriting for technical documents-Understanding audience and purpose, Primary and secondary research - Surveys and interviews - Research methods

UNIT II COMPONENTS OF TECHNICAL DOCUMENTS **9**

Introductions – Abstracts – Definitions – Titles and headings - Effective visual design – Summaries – Technical descriptions – conclusions

UNIT III TYPES OF TECHNICAL REPORT **9**

Formal Technical Reports - Progress and research reports - Incidence reports - Feasibility reports - Evaluation reports – Analytical and informational reports - Executive summaries.

UNIT IV LANGUAGE **9**

Style – Accuracy – Brevity – Clarity – Tone – Vocabulary – Formal and impersonal language – Structure of the report - Plagiarism

UNIT V WRITING PROPOSALS **9**

Nature and significance –Types of proposals - Persuasive elements - Request for proposals – Structure and parts of a proposal

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Acquire a working knowledge of writing strategies, formats and templates of professional writing.

CO2: Analyse communication-related problems of technical documents from number of genres.

CO3: Use visuals to communicate a large amount of information quickly and efficiently

CO4: Enhance writing skills to produce effective reports confidently

TEXT BOOKS:

1. Daniel G. Riordan, Steven E. Pauley, Biztantra: Technical Report Writing Today, 8th Edition (2004).
2. Rizvi M Ashraf, (2005). Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd. New Delhi.

3. Alred, G. (2011). Handbook of Technical Writing (10th ed.). New York: St Martin's. (OPTIONAL)

REFERENCES:

6. M. Frank. Writing as thinking: A guided process approach, Englewood Cliffs, Prentice Hall Reagents.

7. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: A comprehensive grammar of the English language, Longman, London.

8. Daniel G. Riordan & Steven A. Panley: "Technical Report Writing Today" - Biztaantra.

Course Code	PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS	L	T	P	C
ME27O2		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS 9

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING 9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters –- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT VCONTROLLING PRODUCTION & OPERATIONS MANAGEMENT 9

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.

45 HOURS

COURSE OUTCOMES:

CO1: To understand the basics and functions of Production and Operation Management for business owners.

CO2: To learn about the Production & Operation Systems.

CO3: To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.

CO4: To known about the Production & Operations Management Processes in organisations.

CO5: To comprehend the techniques of controlling, Production and Operations in industries.

REFERENCES:

1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.
2. Amitabh Raturi, Production and Inventory Management, , 2008.
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.
5. Chary S.N, Production and Operations Management, TMH Publications, 2010.
6. Terry Hill ,Operation Management. Pal Grave McMillan (Case Study).2005.

Course Code	NANOMATERIALS AND APPLICATIONS	L	T	P	C
ME2703		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications.
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterization techniques employed to characterize the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS **9**

Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS **9**

Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING **9**

Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique

UNIT IV STRUCTURAL CHARACTERISTICS **9**

Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis .

UNIT V APPLICATIONS **9**

Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

45 HOURS

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: Evaluate nanomaterials and understand the different types of nanomaterials

CO2: Explain working of basic instruments used in characterization of nanoparticles.

CO3: Discuss the application of nanotechnology to mechanical and civil domains

CO4: Classify the nanomaterials based on the dimensions.

CO5: Assess the suitability of nanomaterials for various device applications

TEXT BOOKS:

1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007.

2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A

REFERENCES:

1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003

2. Nalwa H.S., Encyclopaedia of Nano-science and Nanotechnology, American Scientific Publishers 2004

3. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008

4. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000

5. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004.

Course Code	CONCEPTS IN MOBILE ROBOTICS	L	T	P	C
ME2704		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce mobile robotic technology and its types in detail.
- To learn the kinematics of wheeled and legged robot
- To familiarize the intelligence into the mobile robots using various sensors
- To acquaint the localization strategies and mapping technique for mobile robot.
- To aware the collaborative mobile robotics in task planning, navigation and intelligence

UNIT I INTRODUCTION TO MOBILE ROBOTS 9

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles

UNIT II KINEMATICS 9

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots

UNIT III PERCEPTION 9

Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction

UNIT IV LOCALIZATION 9

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).

UNIT V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 9

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Evaluate the appropriate mobile robots for the desired application.

CO2: Create the kinematics for given wheeled and legged robot.

CO3: Analyse the sensors for the intelligence of mobile robotics.

CO4: Create the localization strategies and mapping technique for mobile robot.

CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications

TEXT BOOKS

1. Roland Siegwart and Illah Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.

REFERENCES

1. Dragomir N. Nenchev, Atsushi Konno, Teppei Tsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018
2. Mohanta Jagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.
3. Peter Corke, “Robotics, Vision and Control”, Springer, 2017.
4. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.

Course Code	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
ME2705		3	0	0	3

COURSE OBJECTIVES:

- To know the Indian and global energy scenario
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO **9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status. Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT II SOLAR ENERGY **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications

UNIT III WIND ENERGY **9**

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues – Applications.

UNIT IV BIO-ENERGY **9**

io resources – Biomass direct combustion – thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production – Applications

UNIT V OCEAN AND GEOTHERMAL ENERGY **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact **TOTAL: 45 HOURS**

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Discuss the Indian and global energy scenario.

CO2: Describe the various solar energy technologies and its applications.

CO3: Explain the various wind energy technologies.

CO4: Explore the various bio-energy technologies.

CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, McGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 812034470

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015

Course Code	ENERGY TECHNOLOGY	L	T	P	C
ME2706		3	0	0	3

Course Objectives

- Explore diverse energy sources and conversion processes.
- Analyze energy storage systems and efficiency strategies.
- Investigate renewable energy technologies and smart grid concepts.
- Examine environmental impacts, policy frameworks, and emerging innovations.

UNIT I INTRODUCTION **9**

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY **9**

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY **9**

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY **9**

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION **9**

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation **TOTAL: 45 HOURS**

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.

CO2: Students will excel as professionals in the various fields of energy engineering

CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.

CO4: Explain the technological basis for harnessing renewable energy sources.

CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005

2 Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984

3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990

4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008

REFERENCES:

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York

2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002

3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981

Course Code	PLASTIC MATERIALS FOR ENGINEERS	L	T	P	C
ME2707		3	0	0	3

COURSE OBJECTIVES:

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS 9

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures- General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS 9

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS 9

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS 9

Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bio-plastics - bio-PE, bio-PP, bio-PET, polymers for biomedical applications **TOTAL: 45 HOURS**

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO1: To study the importance, advantages and classification of plastic materials

CO2: Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics

CO3: To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins

CO4: Know the manufacture, properties and uses of thermosetting resins based onpolyester, epoxy, silicone and PU

CO5: To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES:

1. Marianne Gilbert (Ed.), Brydson's Plastics Materials, 8 th Edn., Elsevier (2017).
2. J.A.Brydson, Plastics Materials, 7 th Edn., Butterworth Heinemann (1999).
3. Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4 th Edn., CRC press (2006).
4. A. Brent Strong, Plastics: Materials and Processing, 3 rd Edn., Pearson Prentice Hall (2006).
5. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2 nd Edn., CRC press(2016).
6. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999.
7. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988.

Course Code	PROPERTIES AND TESTING OF PLASTICS	L	T	P	C
ME2708		3	0	0	3

COURSE OBJECTIVES:

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS 9

Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and specifications - Importance of standards in the quality control of polymers and polymer products - Preparation of test pieces, conditioning and test atmospheres - Tests on elastomers: processability parameters of rubbers – plasticity, Mooney viscosity, scorch time, cure time, cure rate index, Processability tests carried out on thermoplastics and thermosets: MFI, cup flow index, gel time, bulk density, bulk factor.

UNIT II MECHANICAL PROPERTIES 9

Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers.

UNIT III THERMAL RHEOLOGICAL PROPERTIES 9

Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV ELECTRICAL & OPTICAL PROPERTIES 9

Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE 9

Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance, Acids, alkalies, Flammability tests- oxygen index test.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO1: Understand the relevance of standards and specifications.

CO2: Summarize the various test methods for evaluating the mechanical properties of the polymers.

CO3: To know the thermal, electrical & optical properties of polymers.

CO4: Identify various techniques used for characterizing polymers.

CO5: Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES:

1. F.Majewska, H.Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood Limited Publisher 1977.
2. J.F.Rabek, Experimental Methods in Polymer Chemistry, John Wiley and Sons 1980.
3. R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981.
4. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastics, Allied Publishers Pvt. Ltd., New Delhi, 2003.
5. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007.
6. S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.

Course Code	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
ME2709		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to install moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management

UNIT II ENGINEERING ETHICS **9**

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law

UNIT IV SAFETY, RESPONSIBILITY AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES **9**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXTBOOKS:

1. 1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. 2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, NewDelhi, 2004.

REFERENCES:

1. 1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. 2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
3. 3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”,Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, „ Value Education‟, Vethathiri publications, Erode, 2011

APPENDIX C: MANDATORY COURSES – I

SL. NO.	COURSE CODE	COURSE TITLE
1.	MC2301	Introduction to Women and Gender Studies
2.	MC2302	Elements of Literature
3.	MC2303	Film Appreciation
4.	MC2304	Disaster Management

MANDATORY COURSES – II

SL. NO.	COURSE CODE	COURSE TITLE
1.	MC2401	Well Being with traditional practices (Yoga, Ayurveda and Siddha)
2.	MC2402	History of Science and Technology in India
3.	MC2403	Political and Economic Thought for a Human Society
4.	MC2404	State, Nation Building and Politics in India
5.	MC2405	Industrial Safety
6.	MC2406	Environmental Science

Course Code	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
MC2301		2	0	0	0

COURSE OBJECTIVES:

- To understand the present complex information in a clear and easily understandable way to the target audience, which involves breaking down intricate concepts into simpler terms and providing clear explanations

UNIT I CONCEPTS **9**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour

UNIT II FEMINIST THEORY **9**

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL **9**

Rise of Feminism in Europe and America - Women's Movement in India

UNIT IV GENDER AND LANGUAGE **9**

Linguistic Forms and Gender, Gender and narratives

UNIT V GENDER AND REPRESENTATION **9**

Advertising and popular visual media - Gender and Representation in Alternative Media - Gender and social media

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Acquire socialization on genders, formats and templates of professional writing.

CO2: Analyse communication-related problems of technical documents from number of genres.

CO3: Activity on Women's Empowerment

CO4: Advertising on visual Medias

TEXT BOOKS:

4. Daniel G. Riordan, Steven E. Pauley, Biztantra: Technical Report Writing Today, 8th Edition (2004).
5. Rizvi M Ashraf, (2005). Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd. New Delhi.
6. Alred, G. (2011). Handbook of Technical Writing (10th ed.). New York: St Martin's. (OPTIONAL)

REFERENCES:

1. M. Frank. Writing as thinking: A guided process approach, Englewood Cliffs, Prentice Hall Reagents.

2. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: A comprehensive grammar of the English language, Longman, London.

3. Daniel G. Riordan & Steven A. Panley: "Technical Report Writing Today" - Biztaantra.

Course Code	ELEMENTS OF LITERATURE	L	T	P	C
MC2302		2	0	0	0

COURSE OBJECTIVES:

The students should be made:

- To make the students aware about the finer sensibilities of human existence through an art form.
- The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE **9**

1. Relevance of literature--- a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect, 2. Elements of fiction ---a) Fiction, fact and literary truth, b) Fictional modes and patterns, c) Plot character and perspective.

UNIT II ELEMENTS OF POETRY AND DRAMA **9**

1.Poetry --a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend.

2.Drama-- a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire

UNIT III READINGS **9**

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.

2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.

3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press, 1991.

4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.

5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

3.1 Textbook:

3.2 Reference Books:: To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

UNIT IV OTHER SESSION **9**

4.1 Tutorials:

4.2 Laboratory:

4.3 Project: The students will write a term paper to show their understanding of a particular piece of literature

UNIT V ASSESSMENT: 9

5.1HA:

5.2 Quizzes-HA:

5.3 Periodical Examination: one

5.4 Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.

5.5 Final Exam:

TOTAL: 45 HOURS

COURSE OUTCOMES:

CO1: Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

CO2: To learn about the Production & Operation Systems.

CO3: To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.

CO4: To known about the Production & Operations Management Processes in organisations.

CO5: To comprehend the techniques of controlling, Production and Operations in industries.

REFERENCES:

1. "The Norton Anthology of Theory and Criticism" edited by Vincent B. Leitch: This anthology offers a comprehensive collection of literary theory and criticism, providing insights into various approaches to analyzing literature.
2. "Literature: A Portable Anthology" edited by Janet E. Gardner et al.: This anthology features a diverse selection of literary works from different genres, time periods, and cultures, along with helpful commentary and study guides.

Course Code	FILM APPRECIATION	L	T	P	C
MC2303		2	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

UNIT I THE COMPONENT OF FILMS **9**

A-1: The material and equipment

A-2: The story, screenplay and script

A-3: The actors, crew members, and the director

A-4: The process of film making… structure of a film

UNIT II EVOLUTION OF FILM LANGUAGE **9**

B-1: Film language, form, movement etc.

B-2: Early cinema… silent film (Particularly French)

B-3: The emergence of feature films: Birth of a Nation

B-4: Talkies

UNIT III FILM THEORIES AND CRITICISM/APPRECIATION **9**

C-1: Realist theory; Auteurisms

C-2: Psychoanalytic, Ideological, Feminists

C-3: How to read films?

C-4: Film Criticism / Appreciation

UNIT IV DEVELOPMENT OF FILMS **9**

D-1: Representative Soviet films

D-2: Representative Japanese films

D-3: Representative Italian films

D-4: Representative Hollywood film and the studio system

UNIT V INDIAN FILMS **9**

E-1: The early era

E-2: The important films made by the directors

E-3: The regional films

E-4: The documentaries in India

TOTAL: 45 HOURS

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1: A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these

REFERENCES

1. Film Art: An Introduction" by David Bordwell and Kristin Thompson

2. The Visual Story: Creating the Visual Structure of Film, TV and Digital Media" by Bruce Block

Course Code	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
MC2304		2	0	0	0

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To learn the kinematics of wheeled and legged robot.
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources

UNIT III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and

Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).

CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3: To develop disaster response skills by adopting relevant tools and technology

CO4: Enhance awareness of institutional processes for Disaster response in the country and

CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXT BOOKS

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-938038
4. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361].

REFERENCES

7. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
8. Government of India, National Disaster Management Policy, 2009.
9. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

MANDATORY COURSES II

Course Code	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	L	T	P	C
MC2401		2	0	0	0

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders.

UNIT I HEALTH AND ITS IMPORTANCE 9

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional heath

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time **Simple lifestyle modifications to maintain health** - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET 9

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM.

Common cooking mistakes Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 9

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. **Secrets of traditional healthy living** - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 9

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 9

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Learn the importance of different components of health

CO2: Gain confidence to lead a healthy life.

CO3: Learn new techniques to prevent lifestyle health disorders.

CO4: Understand the importance of diet and workouts in maintaining health

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

Course Code	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
MC2402		2	0	0	0

COURSE OBJECTIVES

A course on the history of science and technology in India can have several objectives, depending on the level of the course (undergraduate, graduate, etc.), the specific focus (e.g., ancient, medieval, modern), and the educational goals of the institution. Here are some common objectives for such a course:

UNIT I CONCEPTS AND PERSPECTIVES 9

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 9

Technology in pre-historic period Beginning of agriculture and its impact on technology - Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA & POST-INDEPENDENT INDIA 9

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions, Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology

TOTAL: 45 HOURS

REFERENCES

1. Science and Technology in Medieval India" by A. Rahman

2. A History of Science in World Cultures: Voices of Knowledge" edited by Scott L. Montgomery and Alok Kumar

Course Code	POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY	L	T	P	C
MC2403		2	0	0	0

COURSE OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

UNIT I INTRODUCTION TO HUMANE SOCIETY **9**

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems**. (Refs: A Nagaraj, M K Gandhi, JC Kumarappa)**

UNIT II CAPITALISM **9**

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. **(Refs: Adam smith, J S Mill)**

UNIT III COMMUNISM **9**

Fascism and totalitarianism - World war I and II. Cold war, Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models **(Refs: Marx, Lenin, Mao, M N Roy)**

UNIT IV WELFARE STATE **9**

Welfare state - Relation with human desires - Empowered human beings, satisfaction - Gandhian thought. Swaraj, Decentralized economy & polity, Community - Control over one's lives - Relationship with nature **(Refs: M K Gandhi, Schumacher, Kumarappa)**

UNIT V INDIAN CIVILIZATION **9**

Essential elements of Indian civilization, Technology as driver of society, Role of education in shaping of society - Future directions **(Refs: Pt Sundarlal, R C Mazumdar, Dharampal) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)**

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO : The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

REFERENCES:

Authors mentioned along with topics above. Detailed reading list will be provided.

Course Code	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
MC2404		2	0	0	0

COURSE OBJECTIVES:

- The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world.
- In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India..

UNIT I DEVELOPMENT OF NATION **9**

Development of Nation-State, sovereignty, sovereignty in a globalized world

UNIT II ORGANS OF STATE **9**

Organs of State – Executive, Legislature, Judiciary - Separation of powers, forms of government unitary-federal, Presidential-Parliamentary

UNIT III THE IDEA OF INDIA **9**

1857 and the national awakening - 1885 Indian National Congress and development of national movement – its legacies - Constitution making and the Constitution of India

UNIT IV GOALS, OBJECTIVE AND PHILOSOPHY **9**

Why a federal system? National integration and nation-building

UNIT V CHALLENGES OF NATION-BUILDING **9**

Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO : It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system..

REFERENCES:

1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
5. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
6. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition
7. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

Course Code	INDUSTRIAL SAFETY	L	T	P	C
MC2405		2	0	0	0

COURSE OBJECTIVES:

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course the student will be able:

- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS:

- R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
- L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring.(1996).Safety management system: Chapman &Hall, England
5. Society of Safety Engineers, USA

Course Code	ENVIRONMENTAL SCIENCE	L	T	P	C
MC2406		2	0	0	0

COURSE OBJECTIVES:

- To study the nature and facts about environment
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMSAND BIODIVERSITY 9

Definition, scope and importance of environment– need for public awareness- concept of an ecosystem– structure and function of an ecosystem– producers, consumers and decomposers energy flow in the ecosystem– ecological succession– food chains, food webs and ecological pyramids– Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)– Introduction to biodiversity definition: genetic, species and ecosystem diversity– biogeographical classification of India– value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values– Biodiversity at global, national and local levels– India as a mega-diversity nation– hot-spots of biodiversity– threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts– endangered and endemic species of India– conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems– pond, river, hill slopes, etc.,

UNIT II ENVIRONMENTALPOLLUTION 9

Definition– causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– soil waste management: causes, effects and control measures of municipal solid wastes– role of an individual in prevention of pollution– pollution case studies– disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site– Urban / Rural / Industrial / Agricultural

UNIT III NATURALRESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people– Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies– Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies– Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies– Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification– role of an individual in conservation of natural resources– Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets– river / forest / grassland / hill / mountain

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

From unsustainable to sustainable development– urban problems related to energy water conservation, rain water harvesting, watershed management– resettlement and rehabilitation of people; its problems and concerns, case studies– role of non-governmental organization- environmental ethics: Issues and possible solutions– climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Waste land reclamation– consumerism and waste products– environment production act– Air (Prevention and Control of Pollution) act– Water (Prevention and control of Pollution) act Wildlife protection act– Forest conservation act– enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATIONAND THE ENVIRONMENT 9

Population growth, variation among nations– population explosion– family welfare programme environment and human health– human rights– value education– HIV / AIDS– women and child welfare– role of information technology in environment and human health– Case studies

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course the student will be able:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

REFERENCES:

1. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2006..
2. G. Tyler Miller and Scott E. Spoolman, “Environmental Science”, Cengage Learning India PVT, LTD, Delhi, 2014.
3. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India PVT LTD,New Delhi, 2007.
4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press, 2005.

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6	VERTICAL 7
DESIGN	**MANUFACTURING**	**THERMAL**	**PRODUCT AND PROCESS DEVELOPMENT**	**COMPUTATIONAL ENGINEERING**	**ROBOTICS AND AUTOMATION**	**QUALITY ENGINEERING**
Design of Jigs, Fixtures and Press Tools	Non-traditional Manufacturing	Advanced Internal Combustion Engines	Value Engineering	Computational Solid Mechanics	Sensors and Instrumentation	Quality Control
Design Concepts in Engineering	Digital Manufacturing and IoT	Alternative Fuels	Green Supply Chain Management	Computational Fluid Dynamics and Heat transfer	Electrical Drives and Control	Total Quality Management
Modern Robotics	Lean Manufacturing	Power Plant Engineering	Materials Science and Engineering	Theory on Computation and Visualization	Embedded Systems and Programming	Principles of Management
Tool Design	Green Manufacturing Design and Practices	Gas Dynamics and Jet Propulsion	Design For X	Artificial Intelligence and Machine Learning-1	Robotics	Entrepreneurship Development
Geometric Dimensioning & Tolerancing	Environment Sustainability and Impact Assessment	Thermal Power Engineering	Ergonomics in Design	Advanced Statistics and Data Analytics	Smart Mobility and Intelligent Vehicles	Logistics in Manufacturing, Supply Chain and Distribution
Advanced Gear Engineering and Precision Component Design	Additive Manufacturing	Pressure Vessels	New Product Development	CAD and CAE	Mechatronics	Sustainable Management
Design for Manufacturing	Precision Manufacturing	Turbo Machines	Product Life Cycle Management	Machine Learning for Intelligent Systems	Drone Technologies	Metrology & Measurements
Composite Materials and Mechanics	Casting and Welding Processes	Refrigeration and Air Conditioning	Sustainability in Design & Manufacturing	Advanced Finite Element Analysis	Automation in Manufacturing	Material Handling Equipment, Repair and Maintenance

PROFESSIONAL ELECTIVES

Course Code	Design of Jigs, Fixtures and Press Tools	L	T	P	C
ME2V11		3	0	0	3

COURSE OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES: 9

Basic elements principles of location -Locating methods and devices -Redundant Location

Principles of clamping - Mechanical actuation pneumatic and hydraulic actuation –

Standard parts Drill bushes and Jig buttons -Tolerances and materials used.

UNIT II JIGS AND FIXTURES 9

Press Working Terminologies – operations- Types of presses - press accessories Computation of press capacity- Strip layout- Material Utilization- Shearing action Clearances -Press Work Materials - Center of pressure- Design of various elements of dies Die Block Punch holder, Die set, guide plates- Stops Strippers Pilots -Selection of Standard parts -Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press Working Terminologies – operations- Types of presses - press accessories - Computation of press -capacity Strip layout- Material Utilization -Shearing action -Clearances Press -Work Materials - Center of pressure- Design of various elements of dies Die Block -Punch holder, Die set, guide plates Stops- Strippers- Pilots Selection of -Standard parts- Design and preparation of four standard views of simple blanking, piercing, -compound and progressive dies

UNIT IV BENDING AND DRAWING DIES 9

Difference between bending and drawing Blank development for above operations –Types of Bending dies-Press capacity-Spring back-knockouts-direct and indirect- pressure pads- Ejectors-Variables affecting Metal flow in drawing operations-draw die inserts-draw beads- ironing-Design and development of bending, forming, drawing, reverse redrawing and combination dies-Blank development for axisymmetric, rectangular and elliptic parts- Single and double action dies

UNIT V FORMING TECHNIQUES AND EVALUATION 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies recent trends in tool design- computer Aids for sheet metal forming Analysis basic introduction - tooling for numerically controlled machines- setup reduction for work holding Single minute exchange of dies Poka Yoke.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Summarize the different methods of Locating Jigs and Fixtures and Clamping principles

CO2 Design and develop jigs and fixtures for given component

CO3 Discuss the press working terminologies and elements of cutting dies

CO4 Distinguish between Bending and Drawing dies.

CO5 Discuss the different types of forming techniques

TEXT BOOKS:

1. Joshi, P.H. Jigs and Fixtures , Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H Press tools - Design and Construction , wheels publishing, 1996

REFERENCES:

1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Donaldson, Lecain and Goold Tool Design , 5th Edition, Tata McGraw Hill, 2017.
4. Hoffman Jigs and Fixture Design , Thomson Delmar Learning, Singapore, 2004.
5. Kempster, Jigs and Fixture Design , Third Edition, Hoddes and Stoughton, 1974.
6. Venkataraman. K., Design of Jigs Fixtures & Press Tools , Tata McGraw Hill, New Delhi, 2005.

Course Code	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
ME2V12		3	0	0	3

COURSE OBJECTIVES:

- Introduce students to the fundamental principles and elements of design in engineering.
- Equip students with the skills to utilize modern design tools and software effectively.
- Encourage the application of design thinking to solve complex engineering problems.
- Foster innovation and creativity through structured design projects.
- Teach the importance and methods of incorporating sustainability into engineering design.

UNIT I PRINCIPLES AND ELEMENTS OF DESIGN: 9

Introduction to engineering design: Definitions, significance, and application areas- Fundamental principles of design: Aesthetics, functionality, usability- Basic elements of design: Line, shape, form, texture, color, and space-Overview of the design process: Stages from conceptualization to implementation.

UNIT II DESIGN TOOLS AND TECHNIQUES 9

Computer-Aided Design (CAD) tools: Features, benefits, and application in engineering-Simulation tools and techniques: Use in predicting performance and reducing prototyping costs-Modern prototyping techniques: 3D printing, CNC machining, and rapid prototyping..

UNIT III DESIGN THINKING AND INNOVATIO 9

Ideation and creativity in design: Techniques for brainstorming and idea generation-Applying design thinking in problem-solving: Steps, tools, and methodologies-Case studies in innovative design: Examination of successful design innovations.

UNIT IV CREATIVITY AND INNOVATION IN DESIGN 9

Techniques to enhance creativity: SCAMPER, mind mapping, and other tools-Role of innovation in design: Importance of innovation for competitive advantage-Analyzing and learning from global design innovations.

UNIT V SUSTAINABLE DESIGN PRACTICES 9

Principles of sustainable design: Environmental considerations in design-.Eco-design strategies: Methods for minimizing environmental impact-Case studies in sustainable design: Successful examples of sustainable engineering solutions.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Understand and apply the fundamental principles and elements of design in engineering projects.

CO 2 Utilize advanced tools and software for designing and prototyping.

CO 3 Implement design thinking to enhance innovation and solve complex problems.

CO 4 Foster creativity in designing processes and projects.

CO 5 Integrate sustainability into the design process to create eco-friendly and socially responsible products.

TEXT BOOKS:

1. Dym, C. L., & Little, P. (2014). Engineering Design: A Project-Based Introduction (4th ed.). John Wiley & Sons.
2. Ulrich, K. T., & Eppinger, S. D. (2016). Product Design and Development (6th ed.). McGraw-Hill Education.

REFERENCES:

1. Lockwood, T. (Date). Design Thinking: Integrating Innovation, Customer Experience, and Brand Value. Allworth Press.

2. Kelley, T. (Date). The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm. Currency.

Course Code	MODERN ROBOTICS	L	T	P	C
ME2V13		2	0	2	3

COURSE OBJECTIVES:

- To introduce definition, history of robotics and robot anatomy.
- To learn the simulation of robot kinematics
- To study the grasping and manipulation of robots.
- To study about mobile robot and manipulation.
- To study the applications of industrial, service, domestic robots

UNIT I INTRODUCTION 6

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.

UNIT II SIMULATION OF ROBOT KINEMATICS 6

Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system

UNIT III GRASPING AND MANIPULATION OF ROBOTS 6

Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.

UNIT IV MOBILE ROBOTS 6

Mobile robot, Wheeled Mobile Robots: Kinematic models of omni-directional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control.

UNIT VAPPLICATIONS OF ROBOTS 6

Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

TOTAL : 30 HOURS

MODERN ROBOTICS LABORATORY

Experiments

1. 30 modelling and motion simulation of rotational joint assembly
2. 30 modelling and motion simulation of prismatic joint assembly
3. 30 modelling and motion simulation of Cartesian robot
4. 30 modelling and motion simulation of articulated robot
5. 30 modelling and motion simulation of spherical robot
6. 30 modelling and motion simulation of cylindrical robot

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Discuss the definition, history of robotics and robot anatomy.
2. Develop the simulation of robot kinematics
3. Describe the grasping and manipulation of robots.
4. Explain about mobile robot and manipulation.
5. Discuss the applications of industrial, service, domestic robots.

TEXT BOOKS:

1. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park , Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715
2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751

REFERENCES:

1. Modern Robotics: Designs, Systems and Control, by Jared Kroft, Willford Press (18 June 2019) ISBN-10 : 1682856763
2. Advanced Technologies in Modern Robotic Applications, by Chenguang Yang , Hongbin Ma , Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN 10 : 981109263X
3. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10 : 0816057451
4. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441
5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10 : 1639873732

Course Code	Tool Design	L	T	P	C
ME2V14		3	0	0	3

COURSE OBJECTIVES:

- Selecting the different machine tool mechanisms.
- Designing the Multi speed Gear Box and feed drives.
- Designing the machine tool structures.
- Designing the guide ways and power screws.
- Designing the spindles and bearing

UNIT I INTRODUCTION TO MACHINE TOOL DESIGN 9

Introduction to Machine Tool Drives and Mechanisms, Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT II REGULATION OF SPEEDS AND FEEDS 9

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

UNIT III DESIGN OF MACHINE TOOL STRUCTURES 9

Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriage.

UNIT IV DESIGN OF GUIDEWAYS AND POWER SCREWS 9

Functions and Types of Guide ways, Design of Guide ways, Design of Aerostatic Slide ways, Design of Anti-Friction Guide ways, Combination Guide ways, Design of Power Screws.

UNIT V DESIGN OF SPINDLES AND SPINDLE SUPPORT 9

Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Select the different machine tool mechanisms.

CO2: Design the Multi speed Gear Box and feed drives.

CO3: Design the machine tool structures.

CO4: Design the guide ways and power screws.

CO5: Design the spindles and bearings

TEXT BOOKS:

1. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.

2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCES:

1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 3rd edition 2012
2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2015
3. K Pal, S. K. Basu, "Design of Machine Tools", 6th Edition. Oxford IBH, 2014
4. N. S. Acherkhan, "Machine Tool Design", Volume 2 University Press of the Pacific, 2000
5. F. Koenigsberger, Design Principles of Metal-Cutting Machine Tools, Pergamon Press, 1964

   F. Koenigsberger, Machine Tool Structures, Pergamon Press,1970.

Course Code	GEOMETRIC DIMENSIONING & TOLERANCING	L	T	P	C
ME2V15		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- To familiarize the students in environmental decision-making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities.
- To provide information on the environmental consequences for decision making
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures

UNIT I ENVIRONMENTAL IMPACT ASSESMENT 9

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive

UNIT II ENVIRONMENTAL DECISION MAKING 9

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment

UNIT III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION 9

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT IV LIFE CYCLE ASSESSMENT 9

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting

UNIT V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT 9

Spatial economics – Knowledge economy and urban regions.

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

CO1: Explain the concepts of Environment Sustainability and trained to make decision related to Environment.

CO2: Make decision that has an effect on our environment

CO3: Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure

CO4: Explain the Life cycle assessment of Environmental sustainability

CO5: Explain sustainable urban economic development.

TEXT BOOKS:

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470

REFERENCES:

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development Edward Elgar Publishing, 2007.
2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008
4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
5. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
6. John G. Rau And David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.

Course Code	ADVANCED GEAR ENGINEERING AND PRECISION COMPONENT DESIGN	L	T	P	C
ME2V16		3	0	2	4

Course Objective:

- This course aims to provide students with a comprehensive understanding of advanced gear engineering and the design of related precision components.
- Students will learn fundamental principles, advanced dynamics, and precision techniques essential for designing efficient and reliable gear systems.
- The course will cover topics such as gear geometry, manufacturing processes, lubrication, reliability analysis, and performance evaluation.
- By the end of the course, students will be equipped with the knowledge and skills necessary to design and analyze precision gear systems to meet diverse industrial requirements.

COURSE OUTCOMES:

CO 1: Understand fundamental gear principles, including geometry, manufacturing, and dynamics.

CO2: Apply advanced techniques for gear design, lubrication, and reliability analysis.

CO3: Select appropriate components such as seals, bolts, and cutting tools for precision systems.

CO4: Analyze machine duty, load spectrum, and NVH characteristics in gear systems.

CO5: Utilize quality methods for design optimization and performance evaluation.

CO6: Interpret and apply relevant industry standards for gear design and component selection.

UNIT 1: FUNDAMENTALS AND STANDARDS 9

Introduction to Gears, Gear Nomenclature and Geometry, Gear Ratios and Gear Trains, Gear Manufacturing Processes, Basic Formulas and Equations, Standards and Specifications, Introduction to major gear standards: (ISO, AGMA, DIN), AGMA Load Capacity Equations, Design Considerations.

UNIT 2: ADVANCED GEAR DYNAMICS 9

Geometry of involute Gears, load carrying capacity of involute gears - Surface Durability & Bending Strength, Profile, Lead modifications in gears, Lubrication and additives- Gearbox lubrication, Machinery lubrication, Amount of lubrication requirement, Bearings- Types, Uses of each type, Misalignment, Preloading, System level stiffness.

UNIT 3: ENGINEERING PRECISION 9

Reliability calculation and probabilistic approach for damage, Design of Transmission systems, Sealing technology O-rings, Oil seals - Design Criteria, Selection, Materials, failures, Selection of Bolt and Calculation of Bolt strength, Gear cutting tools.

UNIT 4: PRECISION COMPONENTS AND PERFORMANCE METRICS 9

Spline, Keyways - types, standards available, calculation, Circlips - Types, Selection, Calculation, Machine duty, Load Spectrum of Industrial machines or gearboxes, QFD, DFMEA, Power rating, Efficiency, IP Protection of Electric motors.

UNIT 5: ENGINEERING EXCELLENCE 9

NVH (Noise, Vibration and Harshness), Testing standards ASTM D5182, ASTM D4998, ASTM D5182 etc., DIN743-Shaft torsional strength calculation, ISO 281 - Bearing Life Calculation, DIN 3960 - Gear Geometry Parameters, ISO 6336 - Gear strength calculation, VDI 2230 - Bolt Strength calculation, Palmgren-Miner rules, Wohler Curves, Gear tribology

PRACTICAL EXERCISES (TOTAL: 30 HOURS)

1. KISSsoft

   KISSsoft general settings and buttons, Gear, shaft, and bearing modules, Navigation of the software, Gear, shaft and bearing design and optimization techniques

2. SIMCENTER 3D

   Gear contact geometry, Gear contact force- Standard gear contact force – Analytical gear contact forces – Advanced gear contact forces – Damping gear contact forces – Friction gear contact forces - Total gear force evaluation.

3. AMESIM

   Thermodynamics: Steel ball in water bath, Mechanics and vibrations: Free response of a system with one Degree of Freedom, Mechanics and vibrations: Response of a system with one Degree of Freedom (DoF) excited by a sinusoidal force, Hydraulics: Pressure transducer

   Mechanics: Vertical throw, Performing a batch run with Simcenter Amesim, Using the experiment view in Simcenter Amesim, Creating a super component of P.I.D. controller with Simcenter Amesim

4. Friction Testing machine (Brake, Clutch and fluid evaluations).

3. Hydraulic Pulsator for gear tooth bending test.

4. Mechanical Resonance Pulsator.

5. FZG Drag Torque Test Rig.

6. Rolling Element Bearings Power Loss Test Rig.

TOTAL (45+30): 75 HOURS

TEXTBOOKS:

1. "Gear Design Simplified" by Franklin D. Jones, Henry H. Ryffel, and Edgar J. McEvoy, Industrial Press Inc., 1984. ISBN 0831111593, 9780831111595.

2. "Handbook of Gear Design" by Gitin M. Maitra. Mc. Graw Hill, New Delhi. 1994.

3. "Gear Materials, Properties, and Manufacture" by J.R. Davis. ASM International, ISBN: 978-1-62708-345-4. 2005

4. Radzevich, S.P. (Ed.). (2021). Dudley's Handbook of Practical Gear Design and Manufacture (4th ed.). CRC Press. https://doi.org/10.1201/9781003126881

REFERENCES

1. "Lubrication Fundamentals" by J. George Wills. CRC Press. (2001)ISBN-10: 0824705220, ISBN-13: 978-0824705223
2. "Reliability Engineering" by Kailash C. Kapur and Michael Pecht. Publisher: Wiley-IEEE Press, (2011). ISBN-10: 0470638829
3. "Seals and Sealing Handbook" by Robert K. Flitney. Elsevier Science. 2013. ISBN-13: 978-0080982625
4. "Bearing Design in Machinery: Engineering Tribology and Lubrication" by Avraham Harnoy. CRC Press. 2002, ISBN-13: 978-0824707036
5. "Machine Design" by Robert L. Norton. Pearson Publication (2010) ISBN-13: 978-0136123705
6. "Electric Machinery and Transformers" by Bhag S. Guru and Huseyin R. Hiziroglu. Publisher: Oxford University Press. 2000, ISBN-13: 978-0195138900
7. "Noise, Vibration, and Harshness (NVH) Testing and Measurement Techniques" by Geoffrey N. Finlay. Publisher: Wiley. 2013. ISBN-13: 978-1119963539
8. Relevant standards and technical papers from organizations such as ASTM, ISO, AGMA, and DIN.

Course Code	DESIGN FOR MANUFACTURING	L	T	P	C
ME2V17		3	0	0	3

COURSE OBJECTIVES:

- To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- To learn design consideration principles of forming in the design of extruded, stamped, and forged products.
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- To learn design consideration principles of welding in the design of welded products.
- To learn design consideration principles of assembly in the design of assembled products

UNIT I INTRODUCTION AND CASTING **9**

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.

UNIT II FORMING **9**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts

UNIT III MACHINING9

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts

UNIT IV WELDING **9**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment

UNIT V ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.

CO 1 Explain design consideration principles of forming in the design of extruded, stamped, and forged products.

CO 2 Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

CO 3 Explain design consideration principles of welding in the design of welded products.

CO 4 Explain design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill, 1986.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998

REFERENCES:

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempel man, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Henry Peck, "Designing for Manufacture", Sir Isaac Pitman & Sons Ltd., 1973.
5. Matousek, "Engineering Design", Blackie & Sons, 1956.

Course Code	COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
ME2V18		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student:

1. To study the fundamentals of composite material strength and its mechanical behaviour
2. To study the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3. To study Thermo-mechanical behaviour and study of residual stresses in Laminates during processing.
4. To Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.
5. To study the fundamentals of composite material strength and its mechanical

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 9

Definition -Need - General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions - Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina - Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina -Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding - Pultrusion - Filament Winding Other Manufacturing Processes

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations - Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III LAMINA STRENGTH ANALYSIS 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV THERMAL ANALYSIS 9

Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T. E's. C.T. E's for special Laminate Configurations - Unidirectional, Off- axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations - Natural Frequencies

TOTAL: **45 HOURS**

COURSE OUTCOMES:

OUTCOMES: At the end of the course the students would be able to

1. Summarize the various types of Fibers, Equations and manufacturing methods for
2. Derive Flat plate Laminate equations
3. Analyze Lamina strength
4. Analyze the thermal behavior of Composite laminates
5. Analyze Laminate flat plates

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
2. Hyer, M.W., "Stress Analysis of Fiber- Reinforced Composite Materials", McGraw Hill, 1998

REFERENCES:

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
3. Issac M. Daniel and Ori lshai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber," Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

Course Code	NON-TRADITIONAL MANUFACTURING	L	T	P	C
ME2V21		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student:

- To classify non-traditional machining processes and describe mechanical energy
- based non- traditional machining processes.
- To differentiate chemical and electro chemical energy-based processes.
- To describe thermo-electric energy-based processes
- To explain nano finishing processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT IV NANO FINISHING PROCESSES 9

Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems

UNIT V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non traditional machining processes

TOTAL: 45 HOURS

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

1. Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
2. Illustrate chemical and electro chemical energy based processes.
3. Evaluate thermo-electric energy-based processes.
4. Interpret nano finishing processes.
5. Analyze hybrid non-traditional machining processes and differentiate non- traditional machining processes.

TEXT BOOKS

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES

1. 1.Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. 2.Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes:
4. 4.Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
5. 5.Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
6. 6.Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208.

Course Code	DIGITAL MANUFACTURING AND loT	L	T	P	C
ME2V22		3	0	0	3

COURSE OBJECTIVES:

- To study the various aspects of digital manufacturing.
- To inculcate the importance of OM in Product Lifecycle Management and Supply chain Management.
- To formulate of smart manufacturing systems in the digital work environment.
- To interpret loT to support the digital manufacturing.
- To elaborate the significance of digital twin.

UNIT I INTRODUCTION 6

Introduction - Need - Overview of Digital Manufacturing and the Past - Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management - Practical Benefits of Digital Manufacturing - The Future of Digital Manufacturing

UNIT II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT 6

Collaborative Product Development, Mapping Requirements to specifications - Part Numbering, Engineering Vaulting, and Product reuse - Engineering Change Management, Bill of Material and Process Consistency - Digital Mock up and Prototype development - Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM.

UNIT III SMART FACTORY 6

Smart Factory - Levels of Smart Factories - Benefits - Technologies used in Smart Factory Smart Factory in loT- Key Principles of a Smart Factory - Creating a Smart Factory - Smart Factories and Cyber security

UNIT IV INDUSTRY 4.0 6

Introduction - Industry 4.0 -Internet of Things - Industrial Internet of Things - Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cloud computing - Data analytics -Cyber physical systems -Machine to Machine communication - Case Studies.

UNIT V STUDY OF DIGITAL TWIN 6

Basic Concepts - Features and Implementation - Digital Twin: Digital Thread and Digital Shadow-Building Blocks - Types - Characteristics of a Good Digital Twin Platform - Benefits, Impact & Challenges - Future of Digital Twins.

TOTAL :30 HOURS

DIGITAL MANUFACTURING AND loT LABORATORY

Experiments

1. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino
2. Detect the Vibration of an Object Using Arduino

3. Sense a Finger When it is Placed on Board Using Arduino
4. Temperature Notification Using Arduino
5. Switch Light On and Off Based on the Input of User Using Raspberry Pi
6. Connect with the Available Wi-Fi Using Arduino

TOTAL: 30 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1. Impart knowledge to use various elements in the digital manufacturing.

CO2. Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.

CO3. Select the proper procedure of validating practical work through digital validation in Factories.

CO4. Implementation the concepts of loT and its role in digital manufacturing.

CO5. Analyze and optimize various practical manufacturing process through digital twin

TEXT BOOKS:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.

2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCES:

1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things",Springer., Switzerland, 2018.

Course Code	LEAN MANUFACTURING	L	T	P	C
ME2V23		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of 6 SIGMA
- To learning about the lean manufacturing tools.
- To study about the deeper understanding methodologies of Lean manufacturing.
- To study the lean concepts and its elements.
- To learn implementation and challenges of lean manufacturing.

UNIT I BASICS OF 6 SIGMA **9**

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT II INTRODUCTION TO LEAN MANUFACTURING TOOLS **9**

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and POCA for sustaining improvements

UNIT III DEEPER UNDERSTADING METHODOLOGIES **9**

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, POCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration

UNIT IV LEAN ELEMENTS **9**

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects

UNIT V IMPLEMENTATION AND CHALLENGES **9**

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL: 45 HOURS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Discuss the basics of 6 SIGMA

CO2: Elaborate the lean manufacturing tools.

CO3: Illustrate about the deeper understanding methodologies of Lean manufacturing.

CO4: Discuss lean concepts and its elements.

CO5: Describe the implementation and challenges of lean manufacturing

TEXT BOOKS

1. Quality Planning and Analysis- JM Juran & amp; FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile South Asia The Toyota Way: 14 Management Principles

3 Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai.

REFERENCES

1. Quality Council of India https://qcin.org/ & its library.

   https://qcin.org/nbqp/knowledge bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123: Six Sigma, Prof. Jitesh J Thakkar, IIT
4. Kharagpur, Certification course. (Self- Learning). Older/ Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

Course Code	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
ME2V24		3	0	0	3

COURSE OBJECTIVES

1. To introduce the concept of environmental design and industrial ecology.
2. To impart knowledge about air pollution and its effects on the environment.
3. To enlighten the students with knowledge about noise and its effects on the environment.
4. To enlighten the students with knowledge about water pollution and its effects on the environment.
5. To introduce the concept of green co-rating and its need

UNIT I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT 9

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles - Material recycling - Emission less manufacturing- Industrial Ecology- Pollution prevention - Reduction of toxic emission - design for recycle.

UNIT II AIR POLLUTION SAMPLING AND MEASUREMENT 9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation- the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone

UNIT III NOISE POLLUTION AND CONTROL 9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects

UNIT IV WATER DEMAND AND WATER QUALITY 9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT V GREEN CO-RATING 9

Ecological Footprint - Need For Green Co-Rating - Green Co-Rating System - Intent- System Approach- Weightage- Assessment Process - Types Of Rating - Green Co-Benefits - Case Studies Of Green Co- Rating

TOTAL: 45 HOURS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the environmental design and selection of eco-friendly materials.

CO2: Analyse manufacturing processes towards minimization or prevention of air pollution.

CO3: Analyse manufacturing processes towards minimization or prevention of noise pollution.

CO4: Analyse manufacturing processes towards minimization or prevention of water pollution.

CO5: Evaluate green co-rating and its benefits.

TEXT BOOKS

1. Gradel.T.E. and B.R. Allenby - Industrial Ecology - Prentice Hall - 2010
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

REFERENCES

1. Gradel.T.E. and B.R. Allenby - Industrial Ecology - Prentice Hall - 2010
2. Frances Cairncross- Costing the Earth: The Challenge for Governments, the Opportunities for Business - Harvard Business School Press - 1993.
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
4. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
5. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
6. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

Course Code	ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT	L	T	P	C
ME2V25		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- To familiarize the students in environmental decision making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
- To provide information on the environmental consequences for decision making
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

UNIT I ENVIRONMENTAL IMPACT ASSESMENT 9

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT II ENVIRONMENTAL DECISION MAKING 9

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION 9

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT IV LIFE CYCLE ASSESSMENT 9

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting.

UNIT V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT 9

Spatial economics – Knowledge economy and urban regions.

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

CO 1 Explain the concepts of Environment Sustainability and trained to make decision related to Environment.

CO 2 Make decision that has an effect on our environment

CO 3 Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.

CO 4 Explain the Life cycle assessment of Environmental sustainability.

CO 5 Explain sustainable urban economic development

TEXT BOOKS

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194.
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470

REFERENCES

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development –Edward Elgar Publishing, 2007
2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008
4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.

   Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common

   Wealth Publishers, New Delhi, 1992.
5. John G. Rau And David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.

Course Code	ADDITIVE MANUFACTURING	L	T	P	C
ME2V26		2	0	2	3

COURSE OBJECTIVES

The objective of this course is to enable the student,

- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes
- To be familiar with powder bed fusion and material extrusion processes.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

UNIT I INTRODUCTION 6

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping-Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing-Electronics Printing. Business Opportunities and Future Directions - Case studies: Automobile, Aerospace, Healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DFAM) 6

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)-Process-Materials -Applications and Limitations

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 6

Photo polymerization: Stereolithography Apparatus (SLA)- Materials Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (OLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 6

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)-Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 6

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multi-Jet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL: 30 HOURS

ADDITIVE MANUFACTURING LABORATORY

EXPERIMENTS

1. Modelling and converting CAD models into STL file.
2. Manipulation and error fixing of STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts

TOTAL: 30 HOURS

EQUIPMENT REQUIRED – LAB

1. Extrusion based AM machine
2. Resin based AM machine
3. Mechanical design software
4. Open-source AM software for STL editing, manipulation and slicing.

COURSE OUTCOMES:

At the end of this course students shall be able to:

C01: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.

CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.

CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.

CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0

2. Andreas Gebhardt and Jan-Steffen Hotter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Proto typing,

Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.

2. Milan Brandt,"Laser Additive Manufacturing: Materials, Design, Technologies, and

Applications", Woodhead Publishing., United Kingdom, 2016, ISBN:9780081004333.

3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.

4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States,2006, ISBN: 978-1-4614-9842-1.

5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

Course Code	PRECISION MANUFACTURING	L	T	P	C
ME2V27		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student to

- Gain comprehensive knowledge of the fundamental principles and concepts of precision engineering, including dimensional accuracy, surface finish, and geometric tolerances.
- Acquire practical skills in advanced manufacturing techniques such as micro-machining, nano-fabrication, and ultra-precision machining processes used in the production of high-precision components.
- Learn to apply metrology and quality control methods to ensure the accuracy and reliability of precision-manufactured products. This includes the use of coordinate measuring machines (CMM), laser interferometry, and other high-precision measurement tools.
- Explore various applications of precision manufacturing in industries such as aerospace, automotive, electronics, and medical devices. Understand how precision manufacturing techniques contribute to the development of high-performance and reliable products.

UNIT I PRECISION ENGINEERING 9

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy - Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology

UNIT II PRECISION MACHINING 9

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro- milling, micro-grinding, Ultra-precision diamond turning, non-conventional micromachining techniques abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc

UNIT III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling. Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

UNIT IV MECHANICAL AND THERMAL ERRORS 9

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors - background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT V MEASUREMENT AND CHARACTERISATION 9

Optical dimensional metrology of precision features - Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 30 Microscopes, Focus-Based Optica Metrology- Fringe projection method, Measurement of Typical Nano features. Surface metrology - 30 surface topography - Need, Measurement - Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy - Scanning electron Microscopes, scanning probe microscopes, Parameters for characterizing 30 surface topography

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.

CO2: Explain the principle and working of different methods of precision machining.

CO3: Explain the special construction requirements of precision machine tools.

CO4: Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.

CO5: Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS:

1. Jain, V.K., Introduction to micromachining, Narosa publishers, 2018

2. Venktesh V.C., Sudinlzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007

REFERENCES:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
2. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
3. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
4. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

Course Code	CASTING AND WELDING PROCESSES	L	T	P	C
ME2V28		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To study the ferrous casting metallurgy and its applications.
- To study the nonferrous casting metallurgy and its applications.
- To study the ferrous welding metallurgy and its applications.
- To study the welding metallurgy of alloy steels and nonferrous metals and its applications.
- To Identifying the causes and remedies of various welding defects; applying welding standards and codes.

UNIT I FERROUS CAST ALLOYS 9

Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size. Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family & microstructures-Alloying effects- Malleable Iron, ADI, Charge calculations-Effect of normal elements and alloying elements in steels. Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurization dephosphorization, specifications for carbon steels- low alloy steels and stainless steels.

UNIT II NON-FERROUS CAST ALLOYS 9

Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys-problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings.

UNIT III PHYSICAL METALLURGY OF WELDING 9

Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.

UNIT IV WELDING OF ALLOY STEELS AND NON-FERROUS METALS 9

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitization, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions.

UNIT V DEFECTS, WELDABILITY AND STANDARDS 9

Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1. Explain the ferrous casting metallurgy and its applications.

CO2. Explain the non ferrous casting metallurgy and its applications.

CO3. Explain the ferrous welding metallurgy and its applications.

CO4. Explain the welding metallurgy of alloy steels and non ferrous metals and its applications.

CO5. Identify the causes and remedies of various welding defects; apply welding standards and codes.

TEXT BOOKS:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017.
2. A.K.Chakrabarthi, ‘Casting Technology and Cast Alloys,Prentice Hall, 2005.

REFERENCES:

1. ASM International. Handbook Committee, ASM Handbook: Casting. Volume 15, ASM International, 2008.

2. Baldev Raj, Shankar V, Bhaduri A K, “Welding Technology for Engineers”, Narosa Publications, 2009.

3. Beeley P, “Foundry Technology" Butterworth-Heinemann, 2001.

4. R.S.Parmar, “Welding Engineering and Technology”, Khanna Publishers, 2010

5. John Campbell, “Casting", Butterworth-Heinemann, 2003.

Course Code	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	C
ME2V31		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To study the working of Gasoline fuel injection systems and SI combustion.
- To study the working of Diesel fuel injection systems and CI combustion.
- To Identifying the source and measure it; explain the mechanism of emission formation and control methods.
- To study the Selecting alternative fuel resources and its utilization techniques in IC engines.
- To study the advanced combustion modes and future power train systems.

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers

UNIT II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behavior – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers

UNIT III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.

UNIT V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells.

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1. Explain the working of Gasoline fuel injection systems and SI combustion.

CO2. Explain the working of Diesel fuel injection systems and CI combustion

CO3. Identify the source and measure it; explain the mechanism of emission formation and control methods

CO4. Select alternative fuel resources and its utilization techniques in IC engines.

CO5. Explain advanced combustion modes and future power train systems.

TEXT BOOKS:

1. V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw-Hill, 1988.

REFERENCES:

1. B.P. Pundir, “IC Engines Combustion & Emission”, Narosa Publishing House, 2014.
2. Duffy Smith, “Auto Fuel Systems”, The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.
4. K.K. Ramalingam, “Internal Combustion Engine Fundamentals”, SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, “Internal Combustion Engines”, Dhanpat Rai& Sons, 2007

Course Code	ALTERNATIVE FUELS	L	T	P	C
ME2V32		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To expose potential alternate fuels and their characteristics
- To use appropriate synthetic fuels and fuel additives for better combustion characteristics
- To utilise alcohol fuels effectively for lower emissions
- To elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines
- To utilise different gaseous fuels and predict their performance and combustion characteristics.

UNIT I INTRODUCTION 9

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Alcohols, Biodiesel, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas, Fuel standards – ASTM & EN.

UNIT II SPECIAL AND SYNTHETIC FUELS 9

Different synthetic fuels, Merits, and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexifuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

UNIT III ALCOHOL FUELS 9

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols.

UNIT IV BIO-DIESEL FUELS 9

Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines.

UNIT V GASEOUS FUELS 9

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects. Methods of utilisation in engines. Performance, combustion and emission characteristics in engines. Issues & limitation in Gaseous fuels.

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

The students will be able to

CO 1 Expose potential alternate fuels and their characteristics

CO 2 Use appropriate synthetic fuels and fuel additives for better combustion characteristics

CO 3 Utilise alcohol fuels effectively for lower emissions

CO 4 Elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines

CO 5 Utilise different gaseous fuels and predict their performance and combustion characteristics

REFERENCES:

1. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.
2. Pundir B.P, I.C. Engines Combustion and Emission, 2010, Narosa Publishing House.
3. Pundir B.P , Engine Combustion and Emission, 2011, Narosa Publishing House Keith
4. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997

Course Code	POWER PLANT ENGINEERING	L	T	P	C
ME2V33		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To study the coal based thermal power plants.
- To study the diesel, gas turbine and combined cycle power plants.
- To learn the basic of nuclear engineering and power plants.
- To learn the power from renewable energy
- To study energy, economic and environmental issues of power plants

UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants - Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANT 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANADA Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants

UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants - Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biagas and Fuel Cell power systems

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Explain the layout, construction and working of the components inside a thermal power plant.

CO2: Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants

CO3: Explain the layout, construction and working of the components inside nuclear power plants.

CO4: Explain the layout, construction and working of the components inside Renewable energy power plants

CO5: Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw- Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineering by R.K. Rajput 1 January 2016

REFERENCES:

1. EI-Wakil. M.M., "Power Plant Technology", Tata McGraw - Hill Publishing Company Ltd., 2010.
2. Thomas C. Elliott, Kao Chen and Robert C. Swane kamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw - Hill, 1998.
3. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar November 2019.
4. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. 11 January 201

Course Code	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
ME2V34		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student to:

1. To study the fundamentals of compressible flow concepts and the use of gas tables.
2. To learn the compressible flow behaviour in constant area ducts.
3. To study the development of shock waves and its effects.
4. To study the types of jet engines and their performance parameters.
5. To learn the types of rocket engines and their performance parameters

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow - Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. isentropic flow and its relations. isentropic flow through variable area ducts nozzles and diffusers. Use of Gas tables

UNIT II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl - Meyer expansion and relation. Use of Gas tables.

UNIT IV JET PROPULSION 9

Theory of jet propulsion -thrust equation - Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines

UNIT V SPACE PROPULSION 9

Types of rocket engines and propellants. Characteristic velocity - thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Apply the fundamentals of compressible flow concepts and the use of gas tables.

CO2: Analyze the compressible flow behaviour in constant area ducts

CO3: Analyze the development of shock waves and its effects.

CO4: Explain the types of jet engines and their performance parameters

CO5: Explain the types of rocket engines and their performance parameters

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCES:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
2. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
3. Harding, "Handbookof Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
4. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

Course Code	THERMAL POWER ENGINEERING	L	T	P	C
ME2V35		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To classify non-traditional machining processes and describe mechanical energy
- based non-traditional machining processes.
- To differentiate chemical and electro chemical energy-based processes.
- To describe thermo-electric energy-based processes
- To explain nano finishing processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT I FUELS AND COMBUSTION 9

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels - Fuels Analysis – Proximate and Ultimate Analysis - Moisture Determination - Calorific Value -Gross & Net Calorific Values

UNIT II BOILER 9

Types and comparison, Mountings and Accessories. Performance calculations, Boiler trial.

UNIT III AIR COMPRESSORS 9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and lsentropic efficiency. Multistage air compressor with intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT IV REFRIGERATION SYSTEMS 9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration

UNIT V PSYCHROMETRY AND AIR-CONDITIONING 9

Psychrometric properties - Property calculations using Psychrometric chart and expressions. Psychrometric processes - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers - concept and types.

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

At the end of the course the students would be able to

1. Evaluate the fuel properties and arrive at proximate and ultimate analysis of fuels.

2. Analyze different types of boilers and compute their performance parameters.
3. Evaluate the performance parameters of an air compressor.
4. Apply the working principles of various refrigeration systems and perform cop calculations.
5. Analyze the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads

TEXT BOOKS

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017

REFERENCES

1. Anantha narayanan P.N," Basic Refrigeration and Air-Conditioning", 4th Edition, Tata McGraw Hill, 2013.
2. Arora," Refrigeration and Air-Conditioning", 2nd Edition, Prentice Hall of India, 2010.
3. Mathur M.L and Mehta F.S., ''Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4. Nag P.K, "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2010
5. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 20111.

Course Code	PRESSURE VESSELS	L	T	P	C
ME2V36		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the Mathematical knowledge to design pressure vessels and piping
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.
- To learn piping layout and flow diagram.

UNIT I INTRODUCTION **9**

Methods for determining stresses - Terminology and Ligament Efficiency-Applications

UNIT II STRESSES IN PRESSURE VESSELS **9**

Introduction - Stresses in a circular ring, cylinder -Dilation of pressure vessels, Membrane stress Analysis of Vessel - Cylindrical, spherical and, conical heads - Thermal Stresses - Discontinuity stresses in pressure vessels

UNIT III DESIGN OF VESSELS **9**

Design of Tall cylindrical self-supporting process columns - Supports for short vertical vessels - Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement - Pressure Vessel Design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS **9**

Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick-walled cylinders or tubes under external pressure - Effect of supports on Elastic Buckling of Cylinders - Buckling under combined External pressure and axial loading.

UNIT V PIPING **9**

Introduction - Flow diagram - piping layout and piping stress Analysis.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications
2. Analyse stress in pressure vessels
3. Design and analysis of pressure vessels.
4. Analysis of buckling and fracture analysis in vessels
5. Design and analysis piping layout and piping

TEXT BOOKS

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. 11 January 2001

REFERENCES

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. 11 January 2001

Course Code	TURBO MACHINES	L	T	P	C
ME2V37		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student,

- To study the energy transfer in rotor and stator parts of the turbo machines.
- To study the function of various elements of centrifugal fans and blowers.
- To evaluating the working and performance of centrifugal compressor
- To analyzing flow behavior and flow losses in axial flow compressor.
- To study the types and working of axial and radial flow turbines

UNIT I WORKING PRINCIPLES 9

Classification of Turbomachines. Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT II CENTRIFUGAL FANS AND BLOWERS 9

Types - components - working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves - various losses. Fan bearings, drives and noise

UNIT III CENTRIFUGAL COMPRESSOR 9

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT IV AXIAL FLOW COMPRESSOR 9

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses - Stalling and Surging. Free and Forced vortex flow

UNIT V AXIAL AND RADIAL FLOW TURBINES 9

Axial flow turbines - Types - Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Explain the energy transfer in rotor and stator parts of the turbo machines.
2. Explain the function of various elements of centrifugal fans and blowers

3. Evaluate the working and performance of centrifugal compressor.
4. Analyse flow behaviour and flow losses in axial flow compressor.
5. Explain the types and working of axial and radial flow turbines

TEXT BOOKS

1. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011. .
2. Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2011

REFERENCES

1. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, Butterworth- Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996. Saravanamutto, Rogers,
4. Cohen, Straznicky., "Gas Turbine Theory" 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.

Course Code	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
ME2V38		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the basic principles and concepts underlying refrigeration and air conditioning systems, including thermodynamics, heat transfer, and fluid mechanics.
- Learn about the refrigeration cycle, refrigerants, and the laws governing the performance of refrigeration systems.
- Develop the ability to design and analyze various types of refrigeration systems, including vapor compression and absorption systems.
- Evaluate the performance of these systems through calculations of coefficients of performance (COP), energy efficiency ratios (EER), and other relevant metrics.
- Explore methods to improve the energy efficiency of refrigeration and air conditioning systems, including advancements in technology and best practices in system design and maintenance.

UNIT I INTRODUCTION **9**

Introduction to Refrigeration - Unit of Refrigeration and C. .P. Ideal cycles- Refrigerants Desirable properties Classification - Nomenclature - ODP & GWP.

UNIT II CENTRIFUGAL FANS AND BLOWERS **9**

Types - components - working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves - various losses. Fan bearings, drives and noise

UNIT III OTHER REFRIGERATION SYSTEMS **9**

Working principles of Vapour absorption systems and adsorption cooling systems refrigeration- Ejector refrigeration systems- Thermo electric refrigeration- Air refrigeration c- Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES **9**

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **9**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Explain the basic concepts of Refrigeration

CO2 Explain the Vapor compression Refrigeration systems and to solveproblems

CO3 Discuss the various types of Refrigeration systems

CO4 Calculate the Psychrometric properties and its use in psychrometric processes

CO5 Explain the concepts of Air conditioning and to solve problems

TEXT BOOKS

Arora, C.P., "Refrigeration and Air Conditioning",edition, McGraw Hill, New Delhi, 2010.

REFERENCES

1. ASHRAE Hand book, Fundamentals, 2010
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 86.

Course Code	VALUE ENGINEERIG	L	T	P	C
ME2V41		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Study the value engineering process and understand its functions within the process.
- Determine the appropriate value engineering methodology for a given project and propose suitable training for both centralized and decentralized modes.
- Learn various decision-making processes and cost evaluation models and apply them in the product development lifecycle.
- Explore an in-depth understanding of various value engineering applications in human resources, manufacturing, and marketing.
- Demonstrate the implementation of value engineering solutions and propose improvements.

UNIT I VALUE ENGINEERING BASICS 9

Origin, definition, and meaning of value engineering and value analysis-Differences between value analysis, value engineering, and traditional cost reduction techniques-Discussion on types of value functions (Basic and Secondary). Concepts of cost and worth, creativity in Value Engineering-Uses, applications, advantages, and limitations of Value Analysis.

UNIT II VALU ENGINEERING JOB PLAN AND PROCESS 9

Introduction to the seven phases of the job plan- Introduction to the seven phases of the job plan- Use of FAST (Function Analysis System Technique) Diagramming as a Value Engineering tool- Behavioral and organizational aspects of Value Engineering. Ten principles of Value Analysis-Benefits of Value Engineering.

UNIT III VALUE ENGINEERING TECHNIQUES 9

Techniques such as brainstorming, Gordon technique, Morphological Analysis, and ABC Analysis-Decision-making frameworks like Make or Buy Decisions-Function Cost Worth-Analysis (FCWA). Break Even Analysis and Life Cycle Cost (LCC).

UNIT IV WORKSHEETS AND GUIDELINES 9

Preparation and use of worksheets in the general and information phases-Function classification, relationship, and summary. Cost analysis, idea listing, comparison, feasibility ranking. Guidelines for writing value engineering proposals, financial aspects, and life cycle cost analysis. Case studies and discussions.

UNIT V VERSATILITY OF VALUE ENGINEERING 9

Application of value engineering in maintenance, repair activities, and non-hardware projects-Initiating a value engineering program, including introduction, training plans, and career development for value engineering specialties.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Ability to estimate product costs based on value engineering principles in terms of value, functions, and worth.

CO2: Capability to articulate product details through various phases of value engineering.

CO3: Proficiency in selecting and applying appropriate methods and standards on value engineering projects and proposing suitable training.

CO4: Ability to apply querying theory and FAST to perfect a value engineering project implementation.

CO5: Development of various case studies related to value engineering project implementation.

TEXT BOOKS

1. Iyer. S.S., "Value Engineering", New Age International (P) Limited, 9th Edition, 2009.
2. Anil Kumar, and Mukhopadhyaya, "Value Engineering: Concepts, Techniques, and Applications", SAGE Publications, 1st Edition, 2003.

REFERENCES

1. Del L. Younker., "Value Engineering: analysis and methodology", CRC Press, 2003.
2. Richard Park., "Value Engineering A Plan for Invention", CRC Press, 1998.
3. Arthur E. Mudge., "Value Engineering :A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'lsola., "Value Engineering: Practical Applications for Design, Construction, Maintenance and Operations", R.S. Means Company, 1997.
5. Lawrence D. Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015

Course Code	GREEN SUPPLY CHAIN MANAGEMENT	L	T	P	C
ME2V42		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To familiar the various standards and legislation of modern electronic manufacturing.
- To know the conventional electronic processing and lead-free electronic manufacturing techniques.
- To recognize the steps involved in assembly process and understand the need of recycle the electronics
- To implement reliability and product life cycle estimation tools in green electronic manufacturing.
- To demonstrate the green electronic manufacturing procedure in applications

UNIT I INTRODUCTION TO GREEN SUPPLY CHAIN 9

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT II SUSTAINABLE PROCUREMENT AND GREEN SOURCING 9

Basics of IC manufacturing and its process - Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer-based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products.

UNIT III ENVIRONMENTAL IMPACT IN LOGISTICS 9

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments- Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT IV CORPORATE SOCIAL RESPONSIBILITY AND ENVIONMENTAL REGULATIONS 9

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry.

UNIT V GREEN INFORMATION TECHNOLOGY AND SYSTEMS 9

Reliability of green electronics systems, Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management - Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.

CO2: Explain the conventional electronic processing and lead free electronic manufacturing techniques.

CO3: Realize the assembly process and the need of recycle of electronics

CO4: Use reliability and product life cycle estimation tools for electronic manufacturing.

CO5: Validate the green electronic manufacturing procedures in applications.

TEXT BOOKS

1. Green Supply Chain Management, by Charisios Achillas, Dionysis D. Bochtis, Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 1138644617
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

REFERENCES

1. David Austen, Green Electronic Morning, lngleby Gallery, 2006.
2. John Hu. Mohammed Ismail, CMOS High Efficiency on - Chip Power Management, Springer Publications 4th edition, 2011.
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008

Course Code	MATERIALS SCIENCE AND ENGINEERING	L	T	P	C
ME2V43		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Equip students with a thorough understanding of the various physical, chemical, and mechanical properties of materials.
- Teach students to analyze and interpret the microstructures of different materials and their impact on properties.
- Educate students on reading and applying phase diagrams and understanding phase transformations.
- Instruct students on various material processing techniques and their influence on the properties and performance of materials.
- Introduce students to advanced materials like nanomaterials and biomaterials, highlighting their applications and potential in new technologies.

UNIT I INTRODUCTION AND ATOMIC STRUCTURE 9

Overview of Material Science and its significance-Classification of materials based on different criteria-atomic models and atomic bonding types-. Crystal structures and atomic arrangements in solids.

UNIT II MATERIAL PROPERTIES AND THEIR MEASUREMENTS 9

Mechanical properties: Strength, hardness, ductility, and toughness-Testing methods: Tensile, compression, hardness, and impact tests-.Thermal properties: Heat capacity, thermal expansion-Electrical and magnetic properties of materials.

UNIT III IMPERFECTIONS AND PHASE DIAGRAMS 9

Types of imperfections in solids: Point, line, and surface defects-Significance of imperfections in materials-Introduction to phase diagrams and their interpretation-Phase transformations: Nucleation and growth mechanisms.

UNIT IV MATERIALS PROCESSING AND MANUFACTURING 9

Common manufacturing processes: Casting, forming, and joining-Material-specific processing techniques-Surface treatment and heat treatment of metals-Challenges in materials processing and the role of process selection

UNIT V ADVANCED MATERIALS AND FUTURE TRENDS 9

Introduction to nanomaterials, biomaterials, and composite materials-Smart materials: Piezoelectrics, shape memory alloys-Recent advancements in material science- Future trends and applications in material science.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Master the identification and description of material properties for application-specific selections.

CO 2 acquire skills in microstructural analysis to understand material behaviors under varied conditions.

CO 3 proficiently use phase diagrams to predict and manipulate material phase transformations.

CO 4 learn diverse material processing techniques to enhance properties and performance.

CO 5 explore advanced materials, preparing them for innovations in nanotechnology and biomaterials.

TEXT BOOKS

1. Allister, W.D., Jr., and Rethwisch, D.G., "Materials Science and Engineering: An Introduction," 9th Edition, John Wiley & Sons.

2. Askeland, D.R., Fulay, P.P., and Wright, W.J., "The Science and Engineering of Materials," 7th Edition, Cengage Learning.

REFERENCES

1. Smith, W.F., and Hashemi, J., "Foundations of Materials Science and Engineering," 6th Edition, McGraw-Hill Education.

Course Code	DESIGN FOR X	L	T	P	C
ME2V44		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications.
- Learn the design consideration principles of forming in the design of extruded, stamped, and forged products
- Learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- Learn design consideration principles of welding in the design of welded products.
- Learn design consideration principles in additive manufacturing

UNIT I INTRODUCTION 9

General design principles for manufacturability- strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage - Design for disassembly - Design for recyclability - Design for manufacture - Design for energy efficiency - Design to regulations and standards.

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clamp ability - Design for accessibility – Design for assembly - Product design for manual assembly - Product design for automatic assembly – Robotic. Assembly

UNIT IV COMPONENT DESIGN - CASTING CONSIDERATION 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA.

UNIT V DESIGN FOR ADDITIVE MANUFACTURING 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Elaborate the design principles for manufacturability

CO2: Discuss the factors influencing in form design

CO3.: Apply the component design features of various machine.

CO4.: Discuss the design consideration principles of welding in the design of welded products.

CO5.: Discuss the design consideration principles of additive manufacturing.

TEXT BOOKS

1. James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Professional, 1998.

Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts,

2. Architectures and Implementation, Springer, 1998.Design and Manufacturing, McGraw Hill., 2008.

REFERENCES

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.

2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.

3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.

4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.

5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994

Course Code	ERGONOMICS IN DESIGN	L	T	P	C
ME2V45		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce to industrial design based on ergonomics.
- Consider ergonomics concept in manufacturing
- Apply ergonomics in design of controls and display.
- Apply environmental factors in ergonomics design.
- Develop aesthetics applicable to manufacturing and product

UNIT I INTRODUCTION 9

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT II ERGONOMICS AND PRODUCTION 9

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts - Push button, Switches, rotating Knobs. Controls with muscular effort - Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools.

UNIT IV ENVIRONMENTAL FACTORS 9

Colour: Colour and light, Colour and objects, Colour and the eye - after Image, Colour blindness, Colour constancy, Colour terms - Colour circles, Munsel colour notation, reactions to colour and colour combination - colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style

UNIT V AESTHETIC CONCEPTS 9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1	Appreciate ergonomics need in the industrial design.
CO 2	Apply ergonomics in creation of manufacturing system
CO 3	Discuss on design of controls and display.
CO 4	Consider environmental factors in ergonomics design.
CO 5	Report on importance of aesthetics to manufacturing system and product

TEXT BOOKS

1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares, Francisco Rebelo
2. Ergonomics in Product Design by Send points Publishing Co. Ltd

REFERENCES

1. Benjamin W. Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7th Edition, 2002
2. Brain Shakel," Applied Ergonomics Hand Book", Butterworth Scientific London 1988.
3. Bridger, RC., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
5. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

Course Code	NEW PRODUCT DEVELOPMENT	L	T	P	C
ME2V46		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce the fundamental concepts of the new product development
- Develop material specifications, analysis and process.
- Learn the Feasibility Studies & reporting of new product development.
- Study the New product qualification and Market Survey on similar products of new product development
- Learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT I FUNDAMENTALS OF NPD 9

Introduction - Reading of Drawing - Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements - Basics of monitoring of NPD applying Gantt chart, Critical path analysis - Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud-QFD.

UNIT II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards - ISO, DIN, JIS, ASTM, EN, etc. - Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III ESSENTIALS OF NPD 9

RFQ (Request of Quotation) Processing - Feasibility Studies & reporting - CFT (Cross Function Team) discussion on new product and reporting - Concept design, Machine selection for tool making, Machining -Manufacturing Process selection, Machining Planning, cutting tool selection - Various Inspection methods - Manual measuring, CMM - GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT IV CRITERIONS OF NPD 9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT V REPORTING & FORWARD-THINKING OF NPD 9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) - Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing - resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model - Advantages & Limitation of RE, CE (Concurrent Engineering)- Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS

1. Product Development - Sten Jonsson

2. Product Design & Development - Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES

1. Revolutionizing Product Development - Steven C Wheelwright & Kim B. Clark
2. Change by Design
3. Toyota Product Development System - James Morgan & Jeffrey K. Liker
4. Winning at New Products - Robert Brands 3rd Edition
5. Product Design & Value Engineering - Dr. M.A. Bulsara &Dr. H.R. Thakkar

Course Code	PRODUCT MANAGEMENT	L	T	P	C
ME2V47		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Provide students with a comprehensive understanding of the role of a product manager.
- Equip students with tools and methodologies used in product planning and development.
- Enhance students' skills in market analysis and competitive strategy formulation.
- Develop abilities to manage a product through its lifecycle.
- Foster decision-making skills based on data analysis and market feedback.

UNIT I INTRODUCTION TO PRODUCT MANAGEMENT 9

Role and responsibilities of a Product Manager-Overview of the product lifecycle.

Key concepts in product management: market fit, user experience, and business models.

UNIT II PRODUCT PLANNING AND STRATEGY 9

Market research and customer needs analysis-Ideation and concept validation-

Product strategy development: Vision, goals, and roadmaps.

UNIT III PRODUCT DEVELOPMENT PROCESS 9

Agile and lean methodologies for product development-Prioritization techniques: KANO model, MOSCOW method, etc.- Prototyping and MVP (Minimum Viable Product) development.

UNIT IV GO-TO-MARKET STRATEGIES AND MARKETING 9

Product positioning and branding-Marketing mix and product launch strategies-Sales enablement and distribution channels.

UNIT V PRODUCT LIFECYCLE MANAGEMENT 9

Metrics and KPIs for product success-User feedback and continuous improvement-Scaling products and managing product portfolios.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. understand the fundamental role and functions of a product manager across different stages of the product lifecycle.
2. skilled in conducting market research, developing product strategies, and creating actionable roadmaps

3. learn to apply Agile and Lean methodologies effectively, prioritize product features, and prototype efficiently.
4. Master the development and execution of go-to-market strategies, including marketing, branding, and distribution.
5. adept at using key performance indicators to measure product success and integrate user feedback for ongoing product improvement.

TEXT BOOKS

1. Cagan, Marty. "Inspired: How to Create Products Customers Love." 2nd Edition.
2. Perri, Melissa. "Escaping the Build Trap: How Effective Product Management Creates Real Value."

REFERENCES

1. Olsen, Dan. "The Lean Product Playbook: How to Innovate with Minimum Viable Products and Rapid Customer Feedback."

Course Code	SUSTAINABILITY IN DESIGN & MANUFACTURING	L	T	P	C
ME2V48		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Equip students with a broad understanding of environmental issues and sustainability.
- Foster knowledge of biodiversity and ecosystem importance.
- Analyze impacts and management of various pollution types.
- Explore renewable energy sources and conservation strategies.
- Promote understanding of sustainable practices and management in various contexts.

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Focus on the importance of the environment and biodiversity, discussing ecosystem diversity, biodiversity threats, and conservation strategies.

UNIT II ENVIRONMENTAL POLLUTION 9

Analyzes various pollution types including water, air, soil, and noise, alongside waste management practices and environmental protection laws.

UNIT III RENEWABLE SOURCES OF ENERGY 9

Explores energy management, conservation strategies, and new energy sources like hydrogen and tidal energy.

UNIT IV SUSTAINBILITY AND MANAGEMENT 9

Discusses sustainable development goals, economic and social sustainability, climate change, and environmental management in industries.

UNIT V SUSTAINABILITY PRACTICES 9

Covers zero waste concepts, circular economy, sustainable habitat approaches like green buildings and materials, and energy efficiency.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. Recognize the importance of biodiversity, identify ecosystem threats, and learn conservation strategies.
2. Identify and understand various pollution types, learn waste management practices, and comprehend environmental laws.
3. assess various renewable energy sources and understand energy conservation and management.
4. learn about sustainable development goals and practices, focusing on economic and social sustainability.

5. explore sustainable building practices and understand the principles of zero waste and the circular economy.

TEXT BOOKS

1. Botkin, D.B. & Keller, E.A., Environmental Science: Earth as a Living Planet. Wiley; 10th edition (2019). Offers comprehensive coverage of environmental science with a focus on solutions.

2. Gaston, K.J. & Spicer, J.I., Biodiversity: An Introduction. Wiley-Blackwell; 2nd edition (2004). Provides a fundamental understanding of biodiversity and conservation.

3. Kothari, D.P. & Singal, K.C., Renewable Energy Sources and Emerging Technologies. PHI Learning; 2nd edition (2011). Discusses renewable energy sources and technological advancements.

REFERENCES

1. Robertson, M., Sustainability Principles and Practice. Routledge; 3rd edition (2021). Details sustainability principles and their applications.

2. Peirce, J.J., Vesilind, P.A., & Weiner, R., Environmental Pollution and Control. Butterworth-Heinemann; 4th edition (1997). Explores various aspects of environmental pollution and management.

3. Kruger, A. & Seville, C., Green Building: Principles and Practices in Residential Construction. Delmar Cengage Learning; 1st edition (2012). A guide to sustainable building techniques and materials.

Course Code	COMPUTATIONAL SOLID MECHANICS	L	T	P	C
ME2V51		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To study the definition and basics on theory of elasticity
- To learn finite element method and procedure for static linear elasticity
- To study the Non-Linear and History depend problems
- To study time dependent and dynamic problems of Small and large strain visco plasticity
- To study Structural Elements & Interfaces and contact using penalty method

UNIT I BASIC ON THEORY OF ELASTICITY 9

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium. Strain -displacement relations, Stress - strain relations, Lame's constant -cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle

UNIT II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY 9

Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1 D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.

UNIT III NON-LINEAR AND HISTORY DEPEND PROBLEMS 9

Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity - Large strain visco-plasticity.

UNIT IV TIME DEPENDENT AND DYNAMIC PROBLEMS 9

First-order systems - the diffusion equation - Explicit time integration - the Newmark method – Implicit time integration - Modal analysis and modal time integration

UNIT V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT 9

Continuum Beams - Shells - Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions)

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Discuss the definition and basics on theory of elasticity

CO 2 Derive the finite element method for static linear elasticity, solve problems.

CO 3 Discuss the Non Linear and History depend problems, Solve problems.

CO 4 Discuss time dependent and dynamic problems, solve problems.

CO 5 Discuss Structural Elements & Interfaces and contact, solve problems.

TEXT BOOKS

1. L.S.Srinath, Advanced Mechanics Of Solids, 3rd Edition 2008.(0070139881 ·9780070139886).
2. J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020. (939038527X9789390385270).
3. RD.Cook, Concepts and Applications of Finite Element Analysis, 4th Edition 2001 (978-0-471-35605-9).
4. S.Timoshenko, Theory of Elasticity, McGraw-Hill Education (India) Pvt Limited, 2010.(9780070701229-0070701229)
5. G. Ramamurty, Applied Finite Element Analysis, 1.K. International Publishing House Pvt.Limited,2013. (9789380578453- 9380578458)

REFERENCES

1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics) by Miguel Luiz Bucalem and KlausJurgen Bathe I 25 February 2013
2. The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics) by Dominique Chapelle and Klaus-Jurgen Bathe 127 January 2013
3. Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics) by M.Kojic and Klaus-Jurgen Bathe I 22 October 2010
4. High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics) by D. Drikakis and W. Rider 122 October 2010
5. Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer (Computational Fluid and Solid Mechanics) by Ben Q. Li 122 October 2010.

Course Code	COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER	L	T	P	C
ME2V52		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To study the fluid flow simulation techniques and its mathematical behaviour
- To learn the Discretise 1 D and 2D systems using finite difference and finite volume techniques
- To Formulate diffusion -convection problems using finite volume method
- To study the flow field for different types of grids
- To learn the need for turbulence models and its types

UNIT I INTRODUCTION 9

Basics of Computational Fluid Dynamics - Governing equations- Continuity, Momentum and Energy equations - Boundary conditions & Types- Time-averaged equations for Turbulent Flow - Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretization and Numerical errors

UNIT II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY 9

Derivation and implementation of a basic 2D FE code with triangular constant strain elements. Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1 D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods. Accuracy and convergence; the Patch test.

UNIT III NON-LINEAR AND HISTORY DEPEND PROBLEMS 9

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis

UNIT IV TIME DEPENDENT AND DYNAMIC PROBLEMS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants - PISO Algorithms, Computation of internal and external thermal boundary layer.

UNIT V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT 9

Turbulence model requirement and types, mixing length model, Two equation (k-€) models - High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Apply the fundamentals of CFD, and develop case specific governing equations.

CO 2 Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.

CO 3 Implement various mathematical schemes under finite volume method for convention diffusion.

CO 4 Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.

CO 5 Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014.
2. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017.

REFERENCES

1. John. F. Wendt, "Computational Fluid Dynamics - An Introduction", Springer, 2013.

2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.

3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.

4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.

5. Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer'', CRC press, 2002.

Course Code	THEORY ON COMPUTATION AND VISUALIZATION	L	T	P	C
ME2V53		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Develop skills in designing efficient algorithms and rigorously analyzing their time and space complexity.
- Understand various algorithmic paradigms such as divide-and-conquer, dynamic programming, and greedy algorithms.
- Implement these data structures in practical scenarios and understand their impact on performance.
- Utilize software tools and libraries to create visual representations that aid in understanding and communicating computational processes.
- Apply theoretical concepts to solve real-world problems, particularly in areas requiring complex computations and data analysis.

UNIT I REVIEW OF MATHEMATICAL THEORY 9

Sets, Functions, Logical statements, Proofs, Relations, Languages, Principal of Mathematical Induction, Strong Principle, Recursive Definitions, Structural Induction.

UNIT II REGULAR LANGUAGES AND FINITE AUTOMATA 9

Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output – Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, unionintersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, ??- Non Deterministic Finite Automata, Conversion of NFA- ? to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.

UNIT III CONTEXT FREE GRAMMAR (CFG) AND PUSHDOWN AUTOMATA 9

Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity, Unambiguous CFG and Algebraic Expressions, BacosNaur Form (BNF), Normal Form – CNF. Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.

UNIT IV VALUE OF VISUALIZATION 9

Information Visualization, In Readings in Information Visualization, Graphical Excellence, Graphical Integrity, Sources of Graphical Integrity In The Visual Display of Quantitative Information

UNIT V VISUALIZATION DESIGN 9

The Power of Representation, Data-Ink and Graphical Redesign, Data-Ink Maximization and Graphical Design, Data Density and Small Multiples.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Discussing the concepts and techniques of discrete mathematics for theoretical computer science.

CO 2 Explain the different formal languages and their relationship.

CO 3 Discussing to classify and construct grammars for different languages and vice-versa.

CO 4 Explaining the Visualization, Graphical and Quantitative Information.

CO 5 Appling the Visualization design and data Ink..

TEXT BOOKS

1. Introduction to the Theory of Computation by Michael Sipser
2. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman.

REFERENCES

1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill
2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria & amp; Sons
3. Introduction to computer theory By Deniel I. Cohen, Joh Wiley & Sons, Inc
4. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall.

Course Code	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
ME2V54		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the importance, principles, and search methods of Al
- Provide knowledge on predicate logic and Prolog.
- Introduce machine learning fundamentals
- Study of supervised learning algorithms.
- Study about unsupervised learning algorithms

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of Al - History of Al - The state of the art - Risks and Benefits of Al -Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniformcost search - Depth First Search - Depth Limited Search.

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning – Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III LEARNING 6

Machine Learning: Definitions - Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra - Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks - Adaline - Back propagation networks - Decision Tree: Entropy - Information gain - Gini Impurity - classification algorithm - Rule based Classification - Na"ive Bayesian classification - Support Vector Machines (SVM)

UNIT V UNSUPERVISED LEARNING 6

Unsupervised Learning - Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps - Clustering: Definition - Types of Clustering - Hierarchical clustering algorithms - k-means algorithm

TOTAL: 30 HOURS

PRACTICAL EXERCISES: 30 HOURS

Programs for Problem solving with Search

1. Implement breadth first search

2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space
4. Implement and compare Greedy and A* algorithms.

Supervised learning

1. Implement the non-parametric locally weighted regression algorithm in order to fit data points.
2. Select appropriate data set for your experiment and draw graphs
3. Write a program to demonstrate the working of the decision tree based algorithm.
4. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the na"ive Bayesian classifier.

Unsupervised learning

5. Implementing neural network using self-organizing maps
6. Implementing k-Means algorithm to cluster a set of data.
7. Implementing hierarchical clustering algorithm.

Note:

• Installation of gnu-prolog, Study of Prolog (gnu-prolog).

• The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface

• Data sets can be taken from standard repositories

(https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1 : Understand the foundations of Al and the structure of Intelligent Agents

CO2: Use appropriate search algorithms for any Al problem

CO3: Study of learning methods

CO4: Solving problem using Supervised learning

CO5: Solving problem using Unsupervised learning

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley lndia.3 rd ed,

REFERENCES

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Bratko, "Prolog: Programming for Artificial lntelligencell, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020

Course Code	ADVANCED STATISTICS AND DATA ANALYTICS	L	T	P	C
ME2V55		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the basic concepts of linear regression and multiple regression
- To introduce exploratory data analysis
- To study logistic regression models for classification
- To develop the forecasting techniques for the predictions
- To introduce the time series analysis for the prediction of future behave

UNIT I REGRESSION 9

Introduction - Linear regression - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters - Modeling techniques. - Coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-co linearity outliers, Ridge regression

UNIT II EXPLORATORY DATA ANALYSIS 9

Rise of statistics, Data Wrangling, Data Quality. Visual encoding - Mapping Data to Visual Variables, Encoding Effectiveness, Scales & Axes, Aspect Ratio, Regression Lines, Multidimensional Data, Parallel Coordinates, Dimensionality Reduction.

UNIT III LOGISTIC AND MULTINOMIAL REGRESSION 9

Logistic function, Estimation of probability using Logistic regression, Variance, Wald Test, Hosmer Lems how Test, Classification Table, Gini Co-efficient

UNIT IV FORECASTING AND CAUSAL MODELS 9

Moving average, Exponential Smoothing, Casual Models

UNIT V TIME SERIES ANALYSIS 9

Auto regression (AR), Moving Average (MA) Models, ARMA, ARIMA models, Multivariate Models

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Apply the fundamentals of CFD, and develop case specific governing equations.

CO 2 Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.

CO 3 Implement various mathematical schemes under finite volume method for convention diffusion.

CO 4 Solve complex problems in the field of fluid flow and heat transfer with the support of high-speed computers.

CO 5 Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014.
2. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017.

REFERENCES

1. John. F. Wendt, "Computational Fluid Dynamics - An Introduction", Springer, 2013.

2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.

3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.

4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer'', CRC press, 2002.

Course Code	CAD AND CAE	L	T	P	C
ME2V56		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Applying the fundamental concepts of computer graphics and its tools in a generic framework.
- Creating and manipulating geometric models using curves, surfaces, and solids.
- Applying concept of 3D modeling, visual realism, and CAD standard practices in engineering design
- Developing mathematical models for Boundary Value Problems and their numerical solution.
- Formulating solution techniques to solve non-linear problems

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 6

Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation. Standards for computer graphics.

UNIT II GEOMETRIC MODELING 6

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG).

UNIT III VISUAL REALISM and CAD STANDARDS 6

Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – colouring – computer animation. Standards for computer - Graphical Kernel System (GKS) - standards for exchange images Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc

UNIT IV FINITE ELEMENT ANALYSIS 6

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling – Element

Equations – Linear and Higher order Shape functions – Bar, Beam Elements –Applications to Heat Transfer problems.

UNIT V NON-LINEAR ANALYSIS 6

Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and visco-plasticity, stress stiffening, contact interfaces-problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate- Introduction to Analysis Software.

TOTAL: 30 HOURS

CAD & CAE LABORATORY

Experiments

1. Design and animate Piston Cylinder assembly and motion study using CAD software.

2. Design and simulate Connecting rod and crank shaft using CAD software.

3. Design and simulate Two Cylinder Engine assembly using CAD software.

4. Coupled Simulation of structural /thermal analysis

5. Harmonic, Transient and spectrum analysis of simple systems.

6. buckling analysis

OUTCOMES: At the end of the course, the students would be able to

1. Discuss the fundamental concepts of computer graphics and its tools in a generic framework.

2. Create and manipulate geometric models using curves, surfaces and solids.

3. Discuss concept of 3D modeling , visual realism and standard CAD practices in engineering design.

4. Develop the mathematical models for one dimensional finite element problems and their numerical solutions.

5. Formulate solution techniques to solve non-linear problems**.**

TEXT BOOKS

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007

2. Seshu.P, “Textbook of Finite Element Analysis”, PHI Learning Pvt. Ltd., NewDelhi, 2012.

REFERENCES

1. William M Neumann and Robert F. Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc, 1992.
3. Foley, Wan Dam, Feiner and Hughes – “Computer graphics principles & practice”, Pearson Education - 2003
4. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, ButterworthHeinemann,2018.
5. Reddy,J.N. “Introduction to the Finite Element Method”, 4thEdition, Tata McGrawHill,2018.

Course Code	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
ME2V57		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

UNIT IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

UNIT V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Understand basic machine learning techniques such as regression, classification

CO 2 Understand about clustering and segmentation

CO 3 Model a fuzzy logic system with fuzzification and defuzzification

CO 4 Understand the concepts of neural networks and neuro fuzzy networks.

CO 5 Gain knowledge on Reinforcement

TEXT BOOKS

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011

REFERENCES

1. Bruno Siciliano, Oussama Khatib, “Handbook of Robotics”, 2016 2nd Edition, Springer
2. Simon Haykin, “Neural Networks and Learning Machines: A Comprehensive Foundation”, Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, 4th Edition, Chichester, 2011, Sussex Wiley.

Course Code	ADVANCED FINITE ELEMENT ANALYSIS	L	T	P	C
ME2V58		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To study concept of Finite Element Analysis to solve problems involving plate and shell elements
- To learn concept of Finite Element Analysis to solve problems involving geometric and material non linearity
- To study solution techniques to solve dynamic problems
- To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems.
- To study error norms, convergence rates and refinement.

UNIT I BENDING OF PLATES AND SHELLS 9

Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements –Degenerated shell elements-Application and Examples.

UNIT II NON-LINEAR PROBLEMS 9

Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation –Solution procedure Application in Metal Forming Process and Contact Problems.

UNIT III DYNAMIC PROBLEM 9

Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Eigen solution-Sub space Iterative Technique – Response analysis - Houbolt, Wilson, Newmark–Methods – Explicit & Implict Methods-Lanchzos, Reduced method for large size system equations.

UNIT IV FLUID MECHANICS AND HEAT TRANSFER 9

Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming–Navier Stokes Equation–Steady and Transient Solution.

UNIT V ERROR ESTIMATES AND ADAPTIVE REFINEMENT 9

Error norms and Convergence rates–h-refinement with adaptivity – Adaptive refinement.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Apply concept of Finite Element Analysis to solve problems involving plate and shell elements

CO 2 Apply concept of Finite Element Analysis to solve problems involving geometric and material non linearity

CO 3 Formulate solution techniques to solve dynamic problems

CO 4 Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems

CO 5 Investigate error norms, convergence rates and refinement.

REFERENCES

1. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall,1990
2. Logan. D. L.,"A first course in Finite Element Method", Cengage Learning, 2012
3. Reddy, J.N. "An Introduction to Non linear Finite Element Analysis", 2nd Edition, Oxford, 2015
4. Robert D.Cook, David S.Malkus, Michael E.Plesha, Robert J.Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2004.
5. Tirupathi R. Chandrupatla and Ashok D.Belegundu,"Introduction to Finite Elements in
6. Engineering",InternationalEdition,PearsonEducationLimited,2014.
7. Zienkiewicz, O. C., Taylor, R. L. and Zhu. J .Z. ,"The Finite Element Method: Its Basis and Fundamentals",7th Edition, Butterworth-Heinemann,2013.

Course Code	SENSORS AND INSTRUMENTATION	L	T	P	C
ME2V61		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
- To learn about the optical, pressure and temperature sensor
- To understand the signal conditioning and DAQ systems.

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Recognize with various calibration techniques and signal types for sensors.

CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.

CO3: Apply the various sensors and transducers in various applications

CO4: Select the appropriate sensor for different applications.

CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013.

REFERENCES

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001.
2. Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015

Course Code	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
ME2V62		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To familiarize a relay and power semiconductor devices
- To get a knowledge on drive characteristics
- To obtain the knowledge on DC motors and drives.
- To obtain the knowledge on AC motors and drives.
- To obtain the knowledge on Stepper and Servo motor.

UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits

UNIT II DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor

UNIT III DC MOTORS AND DRIVES 9

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT IV AC MOTORS AND DRIVES 9

Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control

UNIT V STEPPER AND SERVO MOTOR 9

Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1: Recognize the principles and working of relays, drives and motors.

CO 2: Explain the working and characteristics of various drives and motors.

CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers

CO 4: Interpret the performance of Motors and Drives.

CO 5: Suggest the Motors and Drivers for given applications

TEXT BOOKS

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.

REFERENCES

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2012.
3. Singh M.D. & Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

Course Code	EMBEDDED SYSTEMS AND PROGRAMMING	L	T	P	C
ME2V63		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To familiarize the architecture and fundamental units of microcontroller.
- To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
- To design the interface circuit and programming of I/O devices, sensors and actuators.
- To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
- To acquaint the knowledge of real time embedded operating system for advanced system Developments

UNIT I INTRODUCTION TO MICROCONTROLLER **6**

Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.

UNIT II PROGRAMMING AND COMMUNICATION **6**

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller

UNIT III PERIPHERAL INTERFACING **6**

I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Ste pper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT IV ARM PROCESSOR **6**

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 – Applications

UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING **6**

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages -– Python for Embedded Systems- GPIO Programming – Interfacing

TOTAL: 30 HOURS

LIST OF EXPERIMENTS

1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051. .
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. UART Serial and Parallel Port Programming of 8051.I2C, SPI and CAN Programming of 8051.
8. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
9. Programming of ARM Processor for Sensor Interface.
10. Stepper Motor and Servo Motor Control Using ARM Processor.
11. Serial Communication of ARM Processor with Computation Platform.
12. Wireless Communication of ARM Processor with Computation Platform.
13. GPIO Programming of Real Time Embedded Operating Systems.
14. IOT application using SBC.

(any 7 experiments) **TOTAL: 30 HOURS**

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.

CO 2: Recognize the role of each functional units in microcontroller, processors and system-on-chip based on the features and specifications.

CO 3: Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing

CO4: Design the circuit and write the programming microcontroller, processors and system on chip

CO 5: Develop the applications using Embedded system

TEXT BOOKS

1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming

Applications", 2003.

REFERENCES

1. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.
2. 2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015
3. 3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.
4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 200

Course Code	ROBOTICS	L	T	P	C
ME2V64		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To learn about basics of robots and their classifications
- To understand the robot kinematics in various planar mechanisms
- To learn about the concepts in robot dynamics
- To understand the concepts in trajectory planning and programming
- To know about the various applications of robots.

UNIT I BASICS OF ROBOTICS 9

Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot.

UNIT II DRIVE CHARACTERISTICS 9

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms

UNIT III ROBOT DYNAMICS 9

Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT IV TRAJECTORY, PATH PLANNING AND PROGRAMMING 9

Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS

UNIT V ROBOT AND ROBOT APPLICATIONS 9

Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: State the basic concepts and terminologies of robots

CO2: Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots

CO3: Derive the Forward and Inverse Kinematics, Dynamics for Various Robots

CO4: Apply the various programming techniques in industrial applications

CO5: Analyse the use of various types of robots in different applications

TEXT BOOKS

1. John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.

2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

REFERENCES

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.

2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, ndEdition, 2010

3. S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800

4. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

Course Code	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
ME2V65		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
- To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
- To learn Basic Control System Theory applied to Autonomous Automobiles.
- To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
- To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

UNIT I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES 9

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

UNIT V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous

Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles

CO2: Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing

CO3: Familiar with the concept of fully autonomous vehicles

CO4: Apply the basic concepts of wireless communications and wireless data networks

CO 5: Analyse the concept of the connected vehicle and its role in automated vehicles.

TEXT BOOKS

1. Intelligent Transportation Systems and Connected and Automated Vehicles, 2016,Transportation Research Board

2. Radovan Miucic, Connected Vehicles: Intelligent Transportation Systems", 2019, Springer

REFERENCES

1. Tom Denton, "Automobile Electrical and Electronic systems, Roultedge", Taylor & Francis Group,5th Edition,2018.

Course Code	MECHATRONICS	L	T	P	C
ME2V66		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Selecting sensors to develop mechatronics systems.
- Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
- Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
- Applying PLC as a controller in mechatronics system.
- Designing and develop the apt mechatronics system for an application

UNIT I INTRODUCTION AND SENSORS **9**

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors

UNIT II 8085 MICROPROCESSOR **9**

Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE **9**

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER **9**

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC

UNIT V ACTUATORS AND MECHATRONICS SYSTEM DESIGN **9**

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with Examples – Case studies of Mechatronics Systems – Pick and Place Robot –Engine Management system – Automatic Car Park Barrier.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Select sensors to develop mechatronics systems.

CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.

CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.

CO4: Apply PLC as a controller in mechatronics system.

CO5: Design and develop the apt mechatronics system for an application.

TEXT BOOKS

1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.

2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013

REFERENCES

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.
5. Smaili. A and Mrad. F, "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2007.

Course Code	DRONE TECHNOLOGIES	L	T	P	C
ME2V67		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications.

UNIT IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone

CO3: Select appropriate sensors and actuators for Drones

CO4: Develop a drone mechanism for specific applications

CO5: Create the programs for various drones.

TEXT BOOKS

1.Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.

2.Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016

2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

Course Code	AUTOMATION IN MANUFACTURING	L	T	P	C
ME2V68		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

1. To give a brief exposure to automation principles and control technologies.
2. To introduce the concept of fixed automation using transfer lines.
3. To train the students in the programmable automation such as CNC and industrial robotics.
4. To provide knowledge on the use of automated material handling, storage and data capture

UNIT I MANUFACTURING OPERATIONS 9

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics.

UNIT II CONTROL TECHNOLOGIES 9

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

UNIT III TRANSFER LINES 9

Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.

UNIT IV NUMERICAL CONTROL AND ROBOTICS 9

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications –End effectors – Industrial applications.

UNIT V AUTOMATED HANDLING AND STORAGE 9

Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1: Ability to understand the requirements of automation in manufacturing systems.

CO2: Knowledge in the techniques of machinery automation, shop floor automation.

CO3: Selection of material handling systems for automated industries.

CO4: Gaining basic knowledge in CAD systems.

CO5: Explore how IIoT technologies can enhance data collection, monitoring, and control in manufacturing processes.

TEXT BOOKS

1. Mikell P.Groover, Automation, "Production Systems and Computer Integrated Manufacturing", PHI, 2008.

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

Course Code	QUALITY CONTROL	L	T	P	C
ME2V71		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation – Theory of control chart- uses of control chart –X chart, R chart and chart - process capability –process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves

UNIT V QUALITY AND RELIABILITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development–Product life cycles. Note: Use of approved statistical table permitted in the examination

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO1 Summarize the concept of Quality and Process control for variables

CO2 Apply the process control for attributes

CO3 Explain the concept of sampling and to solve problems

CO4 Explain the concept of Life testing

CO5 Explain the concept Reliability and techniques involved.

TEXT BOOKS

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 2008.

REFERENCES

1. Besterfield D.H., "Quality Control", Prentice Hall, 2013.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 2012
3. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
4. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 2017
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 2001

Course Code	TOTAL QUALITY MANAGEMENT	L	T	P	C
ME2V72		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the Principles and Concepts of Total Quality Management (TQM)
- Analyze Quality Improvement Tools and Techniques
- Evaluate the Role of Leadership and Organizational Culture in TQM
- Develop Strategies for Customer Satisfaction and Quality Assurance
- Implement and Monitor TQM Practices in an Organization

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs – Performance measures

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 - Requirements—Implementation - Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Understanding of Quality Management Principles and Frameworks:

CO 2 Application of TQM Principles in Organizational Contexts:

CO 3 Proficiency in TQM Tools and Techniques:

CO 4 Implementation and Management of Quality Systems:

CO 5 Integration of Environmental and Quality Management Systems:

TEXT BOOKS

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8 th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. ISO 9001-2015 standards

Course Code	PRINCIPLES OF MANAGEMENT	L	T	P	C
ME2V73		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Comprehend the fundamental functions of management, including planning, organizing, leading, and controlling.
- Evaluate the evolution of management thought and how contemporary practices are influenced by historical perspectives.
- Learn to formulate strategic plans and make informed decisions that align with organizational goals.
- Explore the principles of organizational behavior, including motivation, communication, and team development.
- Engage in case studies, simulations, and projects that involve real-world management challenges and scenarios, fostering the ability to manage effectively in diverse environments.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Understanding Management Fundamentals and Organizational Contexts:

CO 2 Competence in Strategic Planning and Decision-Making:

CO 3 Skills in Organizing and Resource Management

CO 4 Ability to Direct and Motivate Teams:

CO 5 Proficiency in Control and Performance Evaluation Techniques:

TEXT BOOKS

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10 th Edition, 2009.

REFERENCES

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7 th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

Course Code	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
ME2V74		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the strategic planning process and how to develop strategies for business growth and sustainability.
- Study methods for identifying and evaluating business opportunities.
- Develop skills to assess the feasibility and viability of new business ideas and ventures.
- Understand various sources of funding for start-ups, including venture capital, angel investors, and crowd funding.
- Learn the principles of financial management, budgeting, and financial planning for new enterprises.

UNIT I ENTREPRENEURAL COMPETENCE **9**

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur.

UNIT II ENTREPRENEURAL ENVIRONMENT **9**

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations.

UNIT III BUSINESS PLAN PREPARATION **9**

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital Budgeting- Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

UNIT IV LAUNCHING OF SMALL BUS **9**

Finance and Human Resource Mobilisation - Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, Start-ups

UNIT V MANAGEMENT OF SMALL BUSINESS **9**

Monitoring and Evaluation of Business - Business Sickness - Prevention and Rehabilitation of Business Units - Effective Management of small Business - Case Studies.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 The learners will gain entrepreneurial competence to run the business efficiently.

CO 2 The learners are able to undertake businesses in the entrepreneurial environment.

CO 3 The learners are capable of preparing business plans and undertake feasible projects.

CO 4 The learners are efficient in launching and develop their business ventures successfully

CO 5 The learners shall monitor the business effectively towards growth and development:

REFERENCES

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, NewDelhi,2016.
2. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
3. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011.
4. Donald F Kuratko,T.V Rao. Entrepreneurship: A South Asian perspective. CengageLearning, 2012.
5. Dr. Vasant Desai, "Small Scale Industries and Entrepreneurship", HPH, 2006.
6. Arya Kumar. Entrepreneurship, Pearson, 2012.
7. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 8th edition, 2017

Course Code	INDUSTRIAL ENGINEERING	L	T	P	C
ME2V75		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the fundamental concepts and history of Industrial Engineering.
- To teach the tools and techniques of operations research used in problem-solving.
- To understand the design and management of manufacturing systems.
- To explore human factors and ergonomics in the engineering process.
- To apply quality control methods in industrial settings.

UNIT I INTRODUCTION TO INDUSTRIAL ENGINEERING 9

History and Evolution of Industrial Engineering- Roles and Responsibilities of Industrial Engineers Systems Approach to Problem Solving.

UNIT II OPERATIONS RESEARCH 9

Linear Programming: Models and Applications- Queuing Theory: Models and Analysis- Simulation Techniques: Applications in Industrial Engineering.

UNIT III MANUFACTURING SYSTEMS 9

Design and Analysis of Manufacturing Systems- Production Planning and Inventory Control - Facility Layout and Location Planning.

UNIT IV HUMAN FACTORS ENGINEERING 9

Ergonomics and Workstation Design-Human-Machine Interaction-Safety Management Systems.

UNIT V QUALITY CONTROL 9

Fundamentals of Quality Control-Statistical Quality Control Techniques-Total Quality Management.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Understand and apply the fundamental principles and tools of Industrial Engineering.

CO 2 Utilize operations research methodologies to optimize solutions in various industrial scenarios.

CO 3 Design efficient and effective manufacturing systems and processes.

CO 4 Address ergonomic and safety concerns in industrial settings.

CO 5 Implement and manage quality control systems to maintain standards.

TEXT BOOKS

1. Khanna, O. P. (2014). Industrial Engineering and Management. Dhanpat Rai Publications.
2. Turner, W. C., Mize, J. H., Case, K. E., & Nazemtz, J. W. (1993). Introduction to Industrial and Systems Engineering. Prentice Hall.

REFERENCES

1. Taha, H. A. (2017). Operations Research: An Introduction. Pearson Education.
2. Buffa, E. S., & Sarin, R. K. (1987). Modern Production/Operations Management. Wiley.

Course Code	SUSTAINABLE MANAGEMENT	L	T	P	C
ME2V76		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Learn the basic concepts and importance of sustainability in business.
- Gain knowledge on how to implement sustainable and ethical practices in business operations.
- Learn to assess and report on sustainability performance using global standards.
- Acquire skills to formulate and implement sustainability strategies in organizations.
- Study case studies to understand practical applications and outcomes of sustainable management.

UNIT I INTRODUCTION TO SUSTAINABLE MANAGEMENT 9

Definition and concept of sustainability- Triple bottom line approach- Sustainable development goals.

UNIT II SUSTAINABLE BUSINESS PRACTICES 9

Environmental management and green marketing- Corporate social responsibility- Ethical sourcing and sustainability in the supply chain.

UNIT III SUSTAINABILITY REPORTING AND PERFORMANCE 9

Tools and techniques for sustainability assessment- Global reporting initiatives, Carbon disclosure project- Life cycle assessment.

UNIT IV STRATEGIES FOR SUSTAINABLE BUSINESS 9

Policy frameworks for sustainability- Strategic sustainability planning- Stakeholder engagement and communication.

UNIT V CASE STUDIES IN SUSTAINABILITY 9

Success stories of sustainable management in corporations- Innovation and sustainable business models- Emerging trends in sustainable management.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Understand the basic concepts of sustainability and its applications in business.

CO 2 Implement sustainable practices effectively within business operations..

CO 3 Evaluate and report sustainability performance using recognized frameworks.

CO 4 Develop strategic approaches to integrate sustainability into business policies

CO 5 Analyse case studies to understand the impact and implementation of sustainability in business.

TEXT BOOKS

1. Young, S. T., & Dhanda, K. K. (2013). Sustainability: Essentials for Business. SAGE Publications, Inc.
2. Chandler, D. (2016). Sustainable Management: Leadership Ethics. Routledge.

REFERENCES

1. Weybrecht, G. (2010). The Sustainable MBA: The Manager's Guide to Green Business. Wiley.
2. Camilleri, M. A. (2017). Corporate Sustainability, Social Responsibility and Environmental Management. Springer.

Course Code	METROLOGY AND MEASUREMENT	L	T	P	C
ME2V77		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To learn basic concepts of the metrology and importance of measurements.
- To teach measurement of linear and angular dimensions assembly and transmission elements.
- To study the tolerance analysis in manufacturing.
- To develop the fundamentals of GD & T and surface metrology.
- To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT I BASICS OF METROLOGY 9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards..

UNIT II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT III TOLERANCE ANALYSIS 9

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV METROLOGY OF SURFACES 9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT V ADVANCES IN METROLOGY 9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multisensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in process monitoring in production - Computed tomography – White light Scanners

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

CO 1 Discuss the concepts of measurements to apply in various metrological instruments.

CO 2 Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.

CO 3 Apply the tolerance symbols and tolerance analysis for industrial applications.

CO 4 Apply the principles and methods of form and surface metrology.

CO 5 Apply the advances in measurements for quality control in manufacturing Industries.:

TEXT BOOKS

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012. 2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

REFERENCES

1. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical Laboratory GuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5. Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley &Sons, 2015.

Course Code	MATERIAL HANDLING EQUIPMENT, REPAIR AND MAINTENANCE	L	T	P	C
ME2V78		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Gain foundational knowledge of material handling principles, system approaches, and problem analysis techniques
- Acquire comprehensive understanding of different types of material handling equipment and their selection criteria.
- Learn to design effective material handling systems, considering influencing factors and layout planning.
- Master maintenance strategies and troubleshooting for essential material handling equipment.
- Explore the latest technologies and automation trends in material handling through case studies.

UNIT I INTRODUCTION TO MATERIAL HANDLING 9

Definitions and Objectives of Material Handling-Principles of Material Handling - Systems Approach in Material Handling -Analysis of Material Handling Problems

UNIT II MATERIAL HANDLING EQUIPMENTS

Types of Material Handling Equipment's-Conveyors, Cranes, Hoists -Elevators, Forklifts -Selection of Material Handling Equipment's

UNIT III DESIGN OF MATERIAL HANDLING SYSTEMS

Factors Influencing the Selection and Design of Material Handling Equipments -Layouts of Material Handling Systems - Design of Integrated Material Handling Systems

UNIT IV MAINTENANCE OF MATERIAL HANDLING EQUIPMENTS

Maintenance Strategies - Preventive, Predictive, and Corrective -Maintenance of Conveyors, Cranes, Hoists, and Elevators-Troubleshooting and Repairs

UNIT V ADVANCED MATERIAL HANDLING SYSTEMS 9

Automation in Material Handling-Recent Developments in Material Handling Systems -Case Studies of Material Handling System

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon the completion of this course, the students will be able to

CO 1 Apply the foundational principles, system approaches, and techniques in material handling.

CO 2 Study the foundational principles, system approaches, and problem-solving techniques in material handling.

CO 3 Study the foundational principles, system approaches, and problem-solving techniques in material handling.

CO 4 Acquired the foundational principles, system approaches, and problem-solving techniques in material handling.

CO 5 Master the foundational principles, system approaches, and problem-solving techniques in material handling.

TEXT BOOKS

1. "Materials Handling Handbook" by Raymond A. Kulwiec, Publisher: Wiley.
2. "Design of Material Handling Equipment" by M. Anoop Kumar, Publisher: CRC Press.

REFERENCES

1. Material Handling Equipment by N. Rudenko, Publisher: Mir Publishers.
2. Introduction to Materials Management by J. R. Tony Arnold, Publisher: Pearson.